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Suicide and Self-Damaging Behavior

A SOCIOBIOLOGICAL PERSPECTIVE

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Preface

It has been well over a century since Darwin published *On the Origin of Species*. Since that time a massive amount of evidence has been gathered in support of his theory. Most of his major postulates and deductions are now considered facts by almost all biologists. Yet evolutionary reasoning has only begun to enter the realm of social scientists. There is no known reason why all of the behavioral and social sciences should not at some level of analysis be subsumed by evolutionary concepts. Such concepts, indeed, should ultimately form the basis for modern life sciences. If the concepts do not prove to be consistent with all of the data from behavioral and social science, then the concepts themselves should be elaborated or modified as necessary. In any event, we must integrate the biological sciences with the human sciences. Our artificial academic interdisciplinary boundaries have led to inbreeding within disciplines and indeed subdisciplines.

The wide attention recently given to sociobiology and behavioral ecology promises some relief from this inbreeding. A small but growing number of anthropologists, psychologists, and sociologists have embraced evolutionary reasoning as a new paradigm for their still immature sciences. The zoologists, meanwhile, in their elaboration of modern synthetic evolutionary theory, are increasingly venturing into the study of human behavior. This presents an enormous opportunity for growth in the behavioral and social sciences. We need more communication among all of the sciences that are relevant to human affairs. Furthermore, we need to attempt more frequently to process the data obtained in empirical studies on a global and synthetic level. Data-based theorization is as important as data collection itself.

Durkheim used suicide to exemplify his sociological paradigm. Suicide, because it is antithetical to almost all other human and nonhuman behavior,

may similarly serve a central role in the development of human sociobiology. It is a clear exception to the predominant life-preserving orientation of behavior. Self-preservation is readily explained through biological concepts, but self-destruction is quite anomalous. By examining this and other exceptions to the prevailing regularities of behavior, we may discover new principles to guide empirical research. My purpose in this volume is to review available data from all concerned disciplines and to examine their status in an evolutionary framework. This is intended to spur the "biologicization" of the social and behavioral sciences. I would only hope that my deductions and postulates will be scrutinized in a scientifically rigorous fashion; undoubtedly much will need modification in the light of future data.

There has also been tremendous growth in the neurological sciences and physiological psychology. I have attempted to integrate this other aspect of biology, where it is relevant, with data on self-damaging behavior from the social and behavioral sciences. Again, the synthesis is of a tentative and heuristic nature, and should be superseded or elaborated in light of future empirical data.

I am indebted to the many reviewers, commentators, questioners, and critics who have redirected my thinking and reading during the course of this work. I would like especially to thank my wife, Jennifer deCatanzaro, for her patience, knowledge of general ecology, and countless hours of help in proofreading. Wendy Tasker and Beverly Pitt helped tremendously through their skills in word processing. Sheila Campbell typed the tables, and Randolph Knipping drew the figures. Elton Ngan, Glen Canavan, Beverly McLeod, and Marie Lise Royer helped with some of the library research. My father, C. J. deCatanzaro, lent me some of his knowledge of antiquity, and my colleague, Martin Daly, helped clarify my thinking about issues in sociobiology in a number of conversations.

1

The Apparent Anomaly of Self-Destructive Behavior

Everything naturally loves itself and preserves itself in being; suicide is against natural inclination and contrary to the charity which a man ought to bear towards himself.[1]

—Thomas Aquinas

Self-murder is a crime most remote from the common nature of all animals.[2]

—Josephus

The act of self-destruction rudely challenges our supposed love of life and fear of death.[3]

—*Seiden*

All of these quotes suggest that self-destructiveness is alien to natural law and against the ordinary orientation of behavior. Yet apart from brief allusions to an apparent paradox, there has been almost no examination of the fundamental biobehavioral problem that self-destructiveness presents. I would like here to argue that by examining the ultimate biological determinants of self-destructive behavior, and by so confronting this paradox, we may gain a more profound understanding of both it and behavioral processes in general.

Almost all behavior displayed by organisms is oriented toward the

[1] In *Summa Theologica*, as quoted by Westermarck, 1908, pp. 252-254.
[2] The historian of the first century A.D., as quoted by Winslow, 1940, p. 18.
[3] In Seiden, 1966, p. 389.

maintenance or advancement of biological fitness. Yet suicide and self-damaging behavior appear to act directly to the contrary of this predominant behavioral orientation and are not uncommon in the human population. Furthermore, self-destructive behavior apparently acts against all that evolution should favor. It seemingly extracts the individual's genes from the population gene pool, whereas selective pressures should favor behavioral predispositions that serve to propagate the individual's genes. In the following chapters, I would like to review the data on self-destructive and self-damaging behavior from a biological perspective, and in so doing attempt to resolve the anomaly that it presents.

Assumptions about the Nature of Adaptive Behavior

During the past few decades, the science of behavioral biology has developed at an exponential rate. It is increasingly clear that a full understanding of an organism's behavior requires a well-founded notion of what the organism is, why it exists, and why it behaves. This demands a behavioral science that is well-rooted in biology. Behavior is entirely a function of biological organisms. We need not only to appreciate physiology, but also to consider evolutionary and ecological constraints on organisms. It is clear, in the wake of modern sociobiological theory, that we must understand the adaptation of behavior to ecological pressures. As E. O. Wilson (1975) forcefully argued, a full conception of the causation of behavior requires consideration of ultimate (evolutionary and ecological) determinants, as well as of proximate (experiential, genetic, and social) determinants.

The behavior of animals generally acts to orient them toward resources that maintain their existence and promote their reproduction. Any perusal of general texts today on the behavior of animals within their natural habitats (e.g., Barash, 1977; Burghardt, 1973; Ewer, 1968; Manning, 1972; E. O. Wilson, 1975) clearly upholds this conclusion. Some of the simplest and evolutionarily oldest behavior is locomotor or consummatory in nature. Locomotor behavior orients the animal toward food, away from predators, and toward chemically and climatically favorable circumstances. It has survival value for organisms existing in changing environments or in those with dispersed resources, allowing them to move to where resources are best at any particular moment. Consummatory behavior involves immediate satisfaction of a biological requirement, such as the intake of food or water, or the completion of copulation.

More complex behavior patterns in species with more developed behavioral repertoires similarly can be linked to the promotion of the organism's biological fitness. Intraspecies threat, appeasement, territoriality,

and aggression may promote optimal social spacing for consumption of resources. Parenting behavior helps to assure successful propagation of genes by the individual. Play in children prepares them for complex adult patterns of behavior through approximation and practice. Communication within a species promotes more efficient resource exploitation. In any species we might examine, we find that time is apportioned among various tasks in a manner that generally corresponds to requirements for survival in the natural habitat.

Indeed, in current behavioral-ecological theory it is tacitly or explicitly held that an organism's behavior is generally oriented toward maximizing its biological fitness (see reviews by Barash, 1977; Dawkins, 1976; Freedman, 1979; Maynard Smith, 1978; Parker, 1978; E. O. Wilson, 1975). This is because, over evolutionary history, organisms that behave in manners adaptive for their particular ecology survive and reproduce, while organisms with less adaptive behavior fail to reproduce. Thus, over generations, selective pressures favor behavioral predispositions conducive to the organism's adaptation, because the genes of the well-adapted members of the previous generation go on to constitute the new generation. Any genes conducive to adaptive behavior, whether directly controlling behavioral phenotypes or having only subtle influence over such phenotypes, should be propagated; genes conducive to maladaptive behavior should generally be deleted from the gene pool.

This is not a teleological position, nor one which ascribes some absolute purpose to behavior. There is no implication that individuals behave adaptively because of any selective pressure acting directly on them. Rather, individuals behave adaptively because of pressures that have acted on previous generations. As the environment changes, capacities originating through genetic change may occasionally confer a selective advantage; older capacities may endure or decline. Many times, new gene-environment interactions may fail to thrive. But to a large extent, adaptive behavior may be inborn in members of animal species because of a long history of natural selection. Generally, organisms behave toward maintaining and improving their biological fitness.

A species' behavior is often very specialized to suit the particular ecological niche it exploits. Within a relatively stable environment, given selection over numerous generations, the behavior of most members of a species should be well attuned to the environment. As long as a member develops within the species' niche, and presuming it is free of mutation and damage from adverse conditions, its behavior should be oriented toward its adaptation and the propagation of its genes. However, within any particular generation, not all individuals are successful. It is only in a general sense that behavior promotes biological fitness—competition, environmental change, genetic muta-

tion, and other factors may lead to individual failures. These failures may occur in great numbers in species, such as many insects or fish, where only a small proportion of the members of one generation successfully propagate (often called r-selectionist species; see MacArthur & Wilson, 1967; E. O. Wilson, 1975). Because of a heavy toll of predation or an unstable environment, such a strategy may optimize the prospects for survival in some species. In many other species (K-selectionist species), including humans, adults tend to produce small numbers of offspring with a large proportion of each generation successfully propagating.

The concept of *biological fitness* usually entails some notion of physiological health and welfare and a capacity to reproduce. Individuals that survive through reproductive ages, engage in reproductive behavior, and nurture offspring to the point where they can be independent will successfully propagate their genes, passing on any genetic predispositions that favored their success. The genes of individuals unsuccessful in these endeavors may be deleted from the gene pool. There are thus strong ecological pressures favoring self-preserving, self-promoting, and reproductive behavior. However, nonreproducing individuals may also act in manners that promote the continued existence of their genes in the gene pool. This is true to the extent that they promote their *inclusive fitness*, by engaging in behavior supporting related, reproducing individuals that share many of their genes by common descent (see Hamilton, 1964; E. O. Wilson, 1975). For example, a celibate or infertile woman may promote the continued existence of her genes by helping to nurture her sister's children.

The conventional classes of behavior studied by experimental psychologists readily fit this framework, as does most human behavior from an intuitive standpoint. Appetitive behavior, such as the seeking of food, water, shelter, and physical comfort, brings the individual toward events improving health and well-being. Aversively motivated behavior, such as avoidance of or escape from pain or other danger, leads the individual away from events that threaten his or her existence. Sexual activity and nurturance of children promote the continued existence of the individual's genes beyond that person's own lifetime. In human society we have developed a set of complex interpersonal contracts that disperse labor; we specialize in our activities in manners that serve our collective survival and fitness. Individuals consequently may behave in manners benefiting others not sharing their genes by common descent; this has been explained through the concept of *reciprocal altruism*, wherein some tacit or explicit contract ensures reciprocity (Trivers, 1971). Individuals exchange labor for mutual benefits to personal well-being. Many forms of human behavior may relate to fitness maximization in very complex and indirect manners. Rather than discuss a wide variety of anom-

alous behavior patterns, I would like to concentrate on the type of behavior that appears to be most contrary to the general orientation of behavior, and that is suicidal and other self-damaging behavior.

Assumptions about Innate Determination versus Learning, and the Influence of Natural Selection

In adopting the notion that behavior should be predisposed toward fitness maximization, it is not necessary to view all behavior as innately determined. There can be little doubt that learning determines many facets of human and nonhuman behavior. Learning processes allow behavioral adaptation within each individual's life span, without requiring genetic change. An organism with a strong capacity to learn is capable of adapting to complex and changing environments, while an organism with relatively fixed behavior may be more restricted in possible ecological niche. In species in which learning plays a major role in behavioral development, it may not be so much the specific topography of behavior as the learning processes themselves that have been developed by selective pressures.

Through experimentation, psychologists and behavioral biologists have identified several learning processes, many of which are common to a large number of species (see, for example, Catania, 1973; Macintosh, 1974; Schwartz, 1976). Simple processes such as habituation and classical conditioning seem to be ubiquitous in the animal kingdom. One of the most important processes is *operant conditioning*. In a sense this process is somewhat analogous to natural selection; it involves differential survival of responses within the individual, whereas natural selection involves differential survival and reproduction of differently responding individuals. Through operant learning, responses followed by a biologically favorable outcome generally increase in frequency; responses followed by no outcome or an unfavorable outcome generally decrease in frequency. Indeed, the principal demonstration of the operant experiment is that organisms tend to repeat responses that improve fitness and delete responses without a favorable consequence for fitness. Increasingly, experimental psychologists are identifying more complex learning processes, especially in humans, including learning through observation or *vicarious learning* (Bandura, 1971a,b) and the formation of verbal associations that may be mediated by complex cognitive processes (see, for example, Crook, 1980; Kintsch, 1977; Lindsay & Norman, 1977; Mayer, 1977).

The ubiquity of some of the basic processes of conditioning (see Honig, 1966; Macintosh, 1974; Nevin & Reynolds, 1973) suggests the existence of innate underpinnings for these processes. Indeed, growing evidence indicates that stereotyped nonassociative physiological mechanisms subserve such processes as reinforcement and punishment. Electrophysiological and pharmacologic studies (see reviews by Gallistel, 1973; Mogenson & Phillips, 1976; Stein, 1978) indicate that neurological and behavioral mechanisms, stereotyped across individuals and possibly species, mediate reinforcement processes. For example, there are data indicating that electrical stimulation of particular brain structures and pathways will produce repetition of a response that the stimulation follows. Electrical stimulation of some of the same structures may produce pleasurable sensations in humans (Valenstein, 1973). Also, chemical stimulation of catecholaminergic systems appears to affect reward or reinforcement mechanisms (Mogenson & Phillips, 1976; Routtenberg, 1978; Stein, 1978). Similarly, it could be argued that there are innate mechanisms involved in punishment processes and response inhibition, since identifiable pathways and structures subserve pain (Melzack, 1973; Pomerantz, 1973; Pourier, Bouvier, Olivier, & Boucher, 1968), as do particular biochemical systems such as those involving endorphins (see reviews by Barchas, Akil, Elliott, Holman, & Watson, 1978; Goldstein, 1978). This all suggests that despite a flexibility in the response repertoire in species with well-developed capacities to learn, many aspects of the learning mechanisms themselves may be relatively fixed in nature. Such processes may have been favored in evolution because they permit a fine adjustment of the individual's behavior to the environmental contingencies specifically affecting him or her.

Many more subtle motivational, emotional, and personality variables may also be relatively inflexible in organisms with a well-developed capacity to learn, including humans. It seems quite plausible that individuals' tendencies to approach or avoid particular stimuli and be reinforced or punished by their presence is often under some influence of genetics or innate factors. As examples, the tendencies to react in various ways to sweet or salty tastes, various sexual stimuli, social signals such as facial expressions, repeated nonreward, and many other events may all be strongly influenced by genetics, despite the fact that behavioral patterns in pursuit or avoidance of such stimuli may be quite flexible. Whereas learning theorists once assumed that most reinforcing, punishing, and eliciting capacities of stimuli were learned through conditioned reinforcement (see Hendry, 1969), their failure to demonstrate strong and durable effects, taken with current sociobiological and ethological theory, suggests that even some of the most subtle motivational effects of stimuli may be partially innate. Furthermore, there is increasing evidence of strong physiological mediation of motivated behavior (see, for example, Carlson, 1977) and affective conditions (Barchas *et al.*, 1978),

suggesting that complex innate factors can influence behavior despite the fact that the response repertoire may be very flexible.

Additional behavioral determinants in organisms with highly flexible behavioral repertoires may be relatively inflexible. Although specific response probabilities may ultimately be determined by consequences and contingencies, initial response acquisition may be influenced by innate factors. Before any contingencies have affected responding within a particular context, certain forms of behavior may be relatively probable or more readily learned within that context than are others. Seligman and Hager (1972) have accordingly spoken of "prepared" and "unprepared" responses—which are, respectively, more and less readily learned by the organism—and have cited considerable evidence.

In summary, despite the strong influence of association and learning over human behavior, many basic motivational and emotional factors may be relatively fixed in nature. Consequently, there is the possibility of the influence of genetics and the pressures of natural selection over motivational conditions. Indeed, evidence from studies of human behavioral genetics further supports this position. Interindividual variance in temperament is in part genetically mediated (see Gershon, Bunney, Leckman, Van Eerdewegh, & DeBauche, 1976). Indeed, there is a considerable amount of evidence now that variance among individuals in personality, temperament, cognitive ability, affect, and degree of mental illness is in part genetically determined (see Fuller & Thompson, 1978). This evidence comes from familial comparisons, particularly those of monozygotic and dizygotic twins. Such behavioral-genetic data provide some of the clearest evidence for a role of innate factors in complex human behavior. We can conclude by accepting Tiger and Fox's (1971) notion that there is a human biogram, genetically carried to predispose toward particular patterns of behavior and motivation. Overlaid on this biogram is the influence of culture, learning, and technology.

The extreme environmentalism that characterized psychology during the first two-thirds of the twentieth century has in one sense defaulted. Ethological, evolutionary, and sociobiological theory, along with developments in behavioral physiology and behavioral genetics, have made it increasingly reasonable to speak of the innate determination of subtle aspects of behavior. None of this is meant to prejudge whether innate factors bear any influence over any particular aspect of behavior, nor to belittle the importance of learning. By no means do I wish to advocate extreme genetic determinism (such as viewpoint would certainly not accord well with the subject matter of this book). Rather, I mean to point out that given fairly complex and subtle controls of innate factors over human motivation, it seems likely that motivation and behavior should be fairly well attuned to ecological contingencies and selective pressures.

The Problem of Self-Destructiveness

Given the nature of selective pressures, the motivational constitution inherited by individuals should orient their behavior toward the promotion of their welfare and the propagation of their genes. This would usually entail that each individual behave in a manner that preserves his or her own existence. Behavior oriented toward self-preservation is generally considered to be a necessary component of fitness maximization; the individual must promote his or her own survival and health, at least until he or she has reproduced and fostered offspring, in order to maximize fitness. Suicidal and self-injurious behavior pose a serious theoretical problem in this context. Such behavior acts against the survival of the behaving individual, and apparently involves a voluntary elimination of biological fitness.

Accordingly, a *cursory* evolutionary analysis suggests that self-destructive behavior should be quite rare in the population. Individuals displaying such behavior apparently extract their genes from the population gene pool. Consequently, any inherited traits that they possess that favor such behavior should be self-limiting. These traits would not be passed on to subsequent generations. Conversely, individuals with any inherited traits that would prevent or predispose against self-destructiveness should have a strong relative selective advantage. Consequently, evolution should have favored traits orienting behavior away from self-destructiveness and toward self-preservation. Given a long history of such selective pressures, individuals should inherit traits that make it quite unlikely that they be self-destructive.

Indeed, organisms are very much structured such that their behavior promotes survival. Most identifiable behavioral mechanisms, from simple reflexes to reinforcement and complex learning mechanisms, clearly do orient the individual toward survival. Most observable behavior is motivated by some potential gain accruing to the behaving individual. However, suicidal behavior is not rare in humans. Such behavior not only involves a failure to respond adaptively or toward the individuals' survival, it involves organized behavior acting directly against the individual's survival. It is anomalous because it is the antithesis of the predominant behavioral pattern and seemingly acts against all that evolution should favor.

My purpose in the following chapters is to define, through a review and interpretation of the available literature, factors that are responsible for deviation of behavior from the predominant, self-preserving pattern. In a recent article on human suicide (deCatanzaro, 1980), I outlined four alternative hypotheses that might account for the occurrence of self-destructiveness. This article extended previous work on self-injurious behavior (deCatanzaro, 1978). Given the responses received from these articles and a subsequent, more comprehensive review of the literature, it is now possible to present a

relatively unified, more complex view of self-destructiveness that incorporates and integrates the hypotheses of the earlier efforts.

A Précis of the Arguments

I will argue first that self-destructiveness occurs as a behavioral characteristic of the human species as a whole. It has occurred as long as human history has been recorded and is present in almost all societies today. Where carefully collected data are available, it occurs at some rate in less technologically developed or primitive cultures as well as in more technologically developed cultures; in some cases the rate in primitive cultures is as high as or higher than that in the technologically developed cultures. It is not, however, found in other species to any appreciable extent, although some forms of adaptive behavior in nonhumans may be associated with a high mortality. The ubiquity of suicide among human cultures makes it especially challenging from a sociobiological perspective. Since such behavior has apparently been present for numerous generations in the human species, it may have presented certain evolutionary contingencies. Suicide recurring over several generations is anomalous and must be attributable to some set of unusual circumstances.

The first major clue comes from an examination of the social ecology of suicide and of the proximate circumstances of the act. Suicide usually occurs in individuals that are subject to some protracted and inescapable stress, or at least who believe they are subject to such stress. Accordingly, suicidal individuals generally have reduced biological fitness relative to others in the population, in that they have a reduced capacity to promote the existence of their genes in future generations. In some exceptional cases again, it may only be a belief that this is their situation. Indeed, suicide is clearly related to reproductive status. In almost all cultures it is much more frequent in single, widowed, or divorced individuals, who are less capable of propagating their genes through reproductive activities, than in those with stable marriages or other relationships allowing them to reproduce. It is perhaps least common in those with successful nurturing relationships with children. Furthermore, suicide frequency increases as a function of age and associated decreases in the capacity for productive and reproductive activity. This notion resolves in large part the biological anomaly of suicide. Insofar as suicide occurs among individuals that are relatively incapable of promoting the existence of their genes in future generations, it effectively does not extract genes from the population gene pool. Consequently, selective pressures would not act to prevent it.

This poses several new questions, however. It leaves open the issue of

why self-destructiveness occurs, and particularly why it occurs where it is relatively immune to selective pressures. Factors that are undoubtedly involved are the human capacity for learning and cognition, and the cultural evolution that this has engendered. The importance of learning, cognition, and culture is underscored by the relative absence of suicide in nonhumans. It is not unlikely that suicide began to occur in the development of the human species as tool use provided more technologies for effecting death and as the human conceptions of death and life goals became more sophisticated. The notion of suicide could diffuse through human culture through observational learning and imitation. Nonetheless, it is difficult to account for the social ecology of suicide simply on the basis of learning and culture.

Another factor is the role of stress and its effects upon gene expression. Suicide, like many forms of behavioral pathology, is usually induced by stress. The exposure of individuals to circumstances with which they cannot cope, or to circumstances outside of the normal environment for their species, may produce a breakdown in adaptive mechanisms. This is because an individual's genotype should only predispose toward adaptiveness in environments like those in which his or her genes have been selected. There are also other variables that allow maladaptive characteristics to recur in the population. Concordant with the notion that suicide can be pathological in nature is evidence that it is often linked with other behavioral pathologies, although evidence suggests that such pathologies are poorly defined or not present in the majority of cases. Factors conducive to pathology are by definition those producing coping difficulties; consequently, pathology helps to account for the social ecology of suicide. Moreover, pathological conditions may account for many of the exceptional cases of suicide, or where it occurs as an act that truly does delete biological fitness.

The notion that genetics plays a role in suicide can be extended by a consideration of gene expression as a function of residual biological fitness. Lethal gene-expression conditions should not be deleted from the population when these are expressed after reproductive age has passed or when reproductive potential is lost in earlier life. Consequently, over evolutionary history, any gene-expression conditions conducive to maladaptive behavior, *but expressed only after reproductive capacity was lost*, would remain and could indeed accumulate in the population. Thus, suicidal motivation could recur over generations if expressed only when there is little residual reproductive capacity to affect. Suicide, like other states arising in senescence or stress, would consequently have no adverse effect on the gene pool, and would not be maladaptive in any biological sense. This gene-expression phenomenon can be reconciled with the notion of cultural involvement in suicide through consideration of complex gene-environment synergies or interactions. This, taken together with the pathology notion, would begin to account fairly completely for the social ecology of suicide.

One more factor may well be involved in this synergy. That factor is *altruism*. Altruism should be facilitated by senescence and the termination of individual reproductive potential, in that it becomes the only means by which an individual can promote inclusive fitness as his reproductive capacity diminishes. It can be demonstrated theoretically that kin and group selection should prevail when individual selection loses power through diminished reproductive potential. Consequently, self-destruction in times of low residual reproductive and productive capacity should be facilitated by its benefits to kin and possibly social grouping. There has been a unique degree and form of interdependency among humans over their evolutionary history.

Forms of self-damaging behavior other than completed suicide are less clearly self-destructive and may relate to a different balance of factors than those precipitating suicide. However, some of the factors are probably common; each form of self-damaging behavior involves a different synergy of factors. One example is the phenomenon of self-injurious behavior, which is found in both human psychiatric populations and in other mammals (especially primates) housed in abnormal or stressful environments. Conditions of stress and pathology seem especially involved in self-injurious behavior. Alcoholism, drug abuse, and risk taking all show some similarity in social ecology to suicide, being more common in the reproductively less capable. These, however, each involve contingencies not affecting suicide; they involve somewhat different synergies of factors.

In summary, self-destructive behavioral patterns each involve complex synergies of culture, stress, and diathesis; the synergies overlap but differ for the various patterns. The arguments presented here should not be viewed as definitive; rather they suggest a framework for future research and should be scrutinized in the light of future empirical research and theorization.

2

The Current Incidence of Suicide and Self-Injury

Self-destructive behavior occurs in diverse forms in humans. While there have been a number of attempts to develop nosological systems (e.g., Durkheim, 1951; Pokorny, 1974; Shneidman, 1968, 1969), often based on presumed etiology, there is no universally accepted framework for classifying such behavior. I would like first to consider the behavior per se, treating self-destruction according to the nature of the act. This involves separate consideration of discrete acts of suicide, unsuccessful discrete suicidal acts, chronic behavior patterns that hasten death, excessive risk-taking, and repetitive self-injurious behavior patterns.

The best statistics regarding such behavior come from modern, technologically developed countries, although even here there are inadequacies. Most data from developed countries derive from clinical and institutional records that may contain several biases (see Douglas, 1967, 1971). The reliability of available statistics from less-developed countries and earlier periods of history is often highly questionable. Nevertheless, it is clear from available information that self-destructive behavior is not rare in contemporary human society, and certain distinct patterns emerge to provide some clues about the determinants of such behavior.

Suicide

Discrete, successful acts of suicide are perhaps the most unequivocal forms of self-destructiveness. They involve single acts that clearly operate against survival, indeed end it by definition. Of course, not all acts directly operating against survival constitute suicide; people who terminate their own lives through misjudgment or accident are usually not considered to have

committed suicide. Rather, suicide is said to involve an "intent" to die and a "deliberate" act inducing death. A satisfactory definition of intent is difficult to derive. Usually the concept connotes verbally expressed motives or anticipations of the consequences of action. Our conception of our motives does not necessarily correspond to the ultimate ecological determination of our behavior; we may not truly understand our own motivation. However, in ascribing intent to die to suicide we assume that the individual is fully cognizant that the behavior will terminate his or her life. Such cognizance or intent is usually inferred after the fact by medical examiners, coroners, or police investigators. This inference may stem from the prior verbal behavior of the individual, a suicide note, or circumstances surrounding the death taken in conjunction with common simple knowledge that certain actions directly induce death and are unlikely to occur through accident, misinformation, or misjudgment.

In Table 2.1 are given recent statistics for rates of death attributable to suicide from various countries keeping such records. It must be considered

Table 2.1
Rates of Suicide per 100,000 Living Population[a]

Country	Rate	Year
Angola[b]	1.0	1972
Argentina	7.8	1977
Australia	11.1	1977
Austria	22.7	1976
Bahamas	0.5	1975
Barbados	1.2	1975
Belgium	16.6	1976
Bolivia[b]	1.4	1966
Bulgaria	12.7	1976
Canada	12.5	1976
Cape Verde	6.1	1975
Channel Islands	11.7	1976
Chile	5.4	1976
Columbia[b]	2.9	1969
Costa Rica	4.4	1977
Cuba	15.0	1971
Czeckoslovakia	22.4	1976
Denmark	23.8	1976
Ecuador[b]	2.7	1975
Egypt	0.1	1975
England and Wales	7.8	1976
Finland	23.5	1974
France	15.4	1970
Germany, Federal Republic of	21.7	1976
Greece	3.4	1976

(Continued)

Table 2.1 (Continued)

Country	Rate	Year
Guadeloupe	3.4	1969
Guatemala	3.4	1972
Guinea-Bissau [b]	12.7	1970
Hong Kong	11.1	1977
Hungary	40.7	1977
Iceland	10.4	1977
Ireland	4.7	1975
Isle of Man	8.6	1974
Israel	4.9	1977
Italy	5.8	1972
Jamaica	1.0	1971
Japan	17.5	1977
Jordan [b]	0.2	1970
Kenya [b]	0.2	1970
Kuwait	0.4	1977
Luxembourg	14.6	1976
Maritius-Maurice	6.4	1977
Mexico	0.7	1975
Mozambique [b]	1.1	1974
Netherlands	8.2	1977
New Zealand	8.8	1976
Nicaragua	1.2	1965
Norway	11.4	1977
Northern Ireland	4.6	1977
Panama [b]	2.6	1975
Paraguay [b]	1.8	1977
Peru [b]	1.8	1977
Philippines [b]	1.1	1974
Poland	11.3	1975
Portugal	8.6	1975
Puerto Rico	9.1	1977
Reunion	6.9	1969
Rhodesia, whites	14.6	1977
Scotland	8.1	1977
Singapore	10.3	1977
South Africa, whites,	14.5	1971
Asian, and Coloured	5.6	1971
Spain	4.2	1975
Sri Lanka	17.2	1968
Sweden	20.8	1975
Switzerland	18.8	1977
Trinidad and Tobago	9.7	1976
United States	12.2	1976
Uruguay	11.1	1976
Venezuela [b]	4.6	1977
Yugoslavia	13.4	1975

[a] Source: *Demographic Yearbook—1978*. United Nations, 1979.
[b] Data of questionable reliability according to United Nations criteria.

here that subtle differences in the definition of suicide, the care taken in compiling the data, classificatory systems for other modes of death, and other biases may reduce the comparability of these statistics. Taken at face value, these data suggest that rates are highest in central and northern European states, especially Hungary, and also high in Japan and Sri Lanka. The rates are fairly high in most non-Hispanic, predominantly Caucasian countries, and also may be high in the Orient and the Indian subcontinent. The rates in less technologically developed or Third World countries appear to be among the lowest, although these statistics are probably also less reliable.

It is important to put the frequency of suicide into the perspective of the totality of death from all causes. Suicide is ranked as the ninth or tenth most common cause of death in the United States, and third or fourth if only young adults are considered (Choron, 1972; *Demographic Yearbook—1975*, 1976; *Demographic Yearbook—1978*, 1979). Such statements are completely relative, however, to how finely the causes of death are classified (Dawkins, 1980). Causes that each exceed suicide in frequency considering all age groups are cardiovascular-renal diseases, malignant neoplasm, influenza and pneumonia, diabetes mellitus, cirrhosis of the liver, diseases of early infancy, non-motor-vehicle accidents, and motor vehicle accidents (Choron, 1972). Of all yearly deaths, suicide in the United States accounts for just over 1% in most recent years. The situation in many other countries is similar. In France, for example, about 1 death out of 50 is attributable to suicide (Baechler, 1980).

In Table 2.2 is given a breakdown of methods employed in suicide by men

Table 2.2
Methods of Suicide per 1000 Cases in 1965[a]

	United States		England and Wales	
Method	Male	Female	Male	Female
Analgesics and narcotics	59	312	246	486
Other solid or liquid poison	27	60	24	19
Domestic gas	6	9	335	322
Other gases	113	87	48	7
Hanging and strangulation	158	124	134	55
Drowning	20	43	60	66
Firearms and explosives	546	240	63	4
Cutting and piercing instruments	19	19	21	5
Jumping from high places	31	48	18	7
Other	20	59	50	19

[a] Source: *World Health Statistics Report*, 1968, pp. 415 & 433.

and women in the United States and in England and Wales. The method employed appears to depend upon both sex and country. In the United States, firearms are employed in most male suicides, whereas females appear to prefer drugs such as barbiturates and tranquilizers. In Great Britain, common methods for both sexes include drugs and domestic gas.

Two of the most important and consistent demographic factors in suicide are sex and age (see Linden & Breed, 1976). Suicide is much more common among males than females in almost all countries of the world. In the United States, for example, the male-female ratio for white populations was 2.4 in 1969-1971; for nonwhites the ratio was 2.8. Among males, suicide rates tend to increase as a direct function of age, being by far the highest among the elderly. Among females, rates generally increase until ages 45-64, after which there may be a slight decrease. These and other factors are discussed in depth in Chapter 5.

There appears to be agreement among suicidologists that several biases in the compilation of statistics on suicide make estimates lower than the actual incidence (e.g., Douglas, 1967; Dublin, 1963; Stengel, 1973). Dublin (1963), for example, estimates that the number of suicides in the United States is at least one-fourth to one-third higher than the official figure. The U.S. suicide figures are largely derived from coroners' verdicts that are sometimes inconclusive, even where the medical evidence for suicide is adequate. As is discussed at length by Douglas (1967, 1971), a verdict of suicide relies heavily on subjective human judgments. Most coroners and medical examiners use common-sense definitions of suicide which involve the dimension of "intentional killing of oneself." The primary difficulty is that the motive must be inferred post hoc from investigation of the physical circumstances of the body, common-sense notions about the relationships of intentions to actions, the relationship of personal situations and personalities to intentions, and so on. In many cases this is facilitated by some clear verbal or written expression on the part of the victim; in others, however, the inference must be based on very incomplete evidence. It is believed by many investigators (e.g., Choron, 1972; Douglas, 1967; Dublin, 1963) that coroners tend to be conservative in their estimates of suicide frequency, often because they may not consider or have access to relevant clinical and personal information (e.g., Dublin, 1963).

Indeed, many actual suicides may be labeled as accidents because of equivocal or incomplete evidence. Moreover, evidence favoring a verdict of suicide may be hidden by relatives or others who believe that such action may shield them from social stigmas attached to suicide. Furthermore, acts of suicide among the elderly or terminally ill may often not enter official statistics when they involve tacit cooperation by professionals in medical institutions (Douglas, 1980).

Subjective inferences and a lack of uniform criteria may lead to variance

within a society in suicide statistics, but the variance among different societies must be far greater. In Roman Catholic and Moslem countries suicide is viewed as a severe disgrace for the deceased and the family. This may make the statistics in Table 2.1 for countries such as Spain, Ireland, Egypt, and Kuwait highly questionable, since a verdict of suicide may be avoided whenever possible. True cross-cultural differences in suicide rates may be obscured by differences in the accuracy of statistics and records. For example, a study by McCarthy and Walsh (1975) examined the underreporting of suicide in Dublin, Ireland. Comparing coroners' verdicts to a clinical assessment of suicide rate by psychiatrists examining the same records, these researchers determined that suicide frequency was consistently underestimated. The discrepancy between the official and "true" suicide rate in Ireland was found to be greater than that in England and Wales or Scotland. Biases in cross-cultural comparisons will be discussed further in Chapter 3.

Parasuicide or Attempted Suicide

The number of apparent suicide attempts that are unsuccessful greatly exceeds the number of successful suicides. Such suicide attempts usually involve some intentional discrete sublethal assault by the individual upon his physical well-being. Estimates of the incidence of such behavior are usually based on medical rather than official records since there is usually no official machinery for the registration of suicide attempts. These estimates suggest that in Great Britain and the United States the number of suicidal attempts is at least 6-10 times the number of suicides, especially in urban centers (Stengel, 1973; Stengel & Cook, 1958). For example, Kreitman and coworkers (1977) have estimated rates of 265 and 428 per 100,000 population for men and women, respectively, in 1974 in the city of Edinburgh, Scotland where they have conducted very thorough studies of sublethal suicidal behavior. Unfortunately, a variety of methodological problems make accurate statistics on the incidence of such behavior virtually impossible to achieve. However all estimates suggest that it is a phenomenon of considerable dimensions.

There is a growing consensus among psychiatric investigators of parasuicide that it differs substantially in nature from successful suicide (e.g., Kreitman, 1977; Stengel, 1973). Although both suicide attempts and successful suicides usually involve individuals under some duress, the age and sex composition of the population of attempters differs substantially from that of successful suicides. More men than women kill themselves, but apparently more women than men attempt suicide (Kreitman, 1977; Parkin & Stengel, 1965; Stengel & Cook, 1958). Furthermore, the incidence of suicide

generally increases with increasing age, whereas the peak rates for suicide attempts are between 20 and 45 years of age, but are lowest after the age of 55 (see Kreitman, 1977, p. 23; Parkin & Stengel, 1965, p. 137). Generally, suicidal acts among males are more likely to be lethal than those among females; suicidal acts among the elderly are more likely to be lethal than those among the young.

Stengel and Cook (1958) were among the first to treat suicide attempts as a different phenomenon from successful suicides. They emphasized that attempted suicide often had social and communicational aspects that might explain the motivation for the act. Indeed, Stengel (1973) has characterized unsuccessful suicidal behavior as an act involving no intent to die. Rather, he has argued that those displaying this behavior arrange events in such a manner that they shall survive the act. For example, individuals may calculate a dose of a drug or toxin that is sublethal or arrange that someone find them in time to prevent their death. Such behavior may result in either transitory or permanent improvements in the attempter's social environment; such an individual is rewarded by increased attention and sympathy from others and engages in the suicidal act in anticipation of survival and achievement of this reward. Kreitman (1977) has accordingly argued that *attempted suicide* is a misnomer, and that the term *parasuicide* is much more apt.

Nonetheless, it is probable that there is variance in the degree of intention to die accompanying sublethal discrete self-damaging acts. It is likely that some of those intending to die survive their attempts, while some of those anticipating survival meet their death through miscalculation. Shneidman (1966) has classified nonfatal suicidal acts with regard to their intention to die as follows: intentioned, subintentioned, unintentioned, and contraintentioned. Contraintentioned acts involve little risk of death, while subintentioned acts involve "unresolved motives" accompanied by a risk of death. Lester (1970) has similarly placed lethality on a continuum rather than a dichotomy, arguing that many attempters later complete the act. Worden (1976) has presented interesting data and discussion of this issue, attempting to measure and rate the relative severity of suicide attempts and to relate this to demographic and personal variables. Treating suicide in terms of the lethality of the behavior avoids the difficulties entailed in defining constructs such as that of "intent." Indeed, in keeping with our discussion of suicide as behavior per se, anomalous because evolution apparently should not allow self-destructiveness, it may be best to consider the lethality of the behavior, rather than the complexities of indirectly inferred and hypothetical proximate motivational processes.

Parasuicidal acts involving relatively little risk of death, and performed in anticipation of rewards derived by the individual in surviving, are beyond the scope of this book, except to the extent that they may explain some cases of true suicide. Such acts are clearly adaptive when committed in anticipation of

reinforcement accruing with survival. If these acts enhance biological fitness, they are not anomalous in terms of the biological referents discussed in Chapter 1. Readers especially interested in discussions of parasuicide should refer to the available works on this subject (e.g., Kreitman, 1977).

Chronic Suicide and Risk Taking

The definition of *suicide* employed above, like that of official statistics, involves the notion of *discrete fatal acts*. However, it is conceivable that chronic behavior patterns may hasten an individual's death and involve some common determination with discrete acts of suicide. Menninger (1938) originally advanced the notion of chronic suicide. He contended that a wide variety of acts, including alcoholism, drug abuse, risk taking, and self-mutilation all constituted suicide of sorts. Within a psychoanalytic framework, Menninger argued that a "death wish" might be expressed in these manners as much as through more direct suicidal acts.

Again, for our purposes it is probably best to avoid hypothetical motivational processes, and rather to focus on potential commonalities in determination of chronic life-threatening behavior and suicide. Even so, discussion of many of these chronic patterns is complicated considerably by a variety of determinants that are quite specific to each of the chronic self-damaging patterns. For example, alcohol consumption clearly involves a wide variety of determinants, many of which are quite outside the scope and purpose of this book. It may be influenced by a variety of adaptive mechanisms involving its caloric value, reinforcement from social facilitation it provides, and whatever transitory value it has in promoting relaxation. Such factors presumably contribute to cases where such consumption becomes excessive and apparently threatens the individual's biological fitness. Similarly, excessive consumption of other drugs may involve some immediate reinforcing value of their physiological and behavioral effects. Also, other drugs may directly stimulate mechanisms involved in reinforcement processes in the brain; their use may become habitual because they stimulate mechanisms producing repetition of antecedent behavior (Schuster & Johanson, 1974). Thus, the chronic abuse of drugs, although potentially life-threatening, may involve some adaptive processes as well as many complex maladaptive processes. Because of the complexity of such behavior, I would like to consider only briefly contributions to its occurrence that may be similar to the determinants of suicide.

As well as chronic self-damaging behavior such as drug abuse, discrete acts involving high risk of death could be considered as suicidal. This may especially be true when an individual displays such behavior repeatedly or

habitually, in which case the cumulative probability is such that the individual is very likely to die as a consequence of this behavior. Of course, some risk taking is involved in many forms of behavior, and where the potential payoff is high, the risk-taking behavior may be viewed as quite adaptive. An assessment of the probabilities for benefit or loss to fitness in cases of such behavior is frequently quite difficult. Consequently, my discussion of risk taking will be brief and limited to cases where there is clearly a high probability of death as a consequence of the behavior.

Chronic self-abusive patterns and excessive risk taking, while more difficult to delineate from similar and more adaptive behavior, may be anomalous for the same reasons as is suicide. An inclusion of such behavior in a definition of suicide would increase considerably the estimates of its incidence. It is interesting to note that Shneidman (1970) has contended that subintentioned death, where the individual hastens his or her own death, may be characteristic of a majority of human deaths.

Self-Injurious or Self-Mutilative Behavior

An additional class of behavior that is clearly life-threatening is self-injurious behavior. This involves stereotyped and repetitive behavior that produces immediate, obvious damage to the body (Tate & Baroff, 1966). This form of behavior is relatively rare, although within certain populations it can be common and persistent.

Repetitive self-injurious behavior is recognized as a symptom of a variety of human clinical syndromes. It is quite common in individuals of very low intellectual functioning, especially those classified as severely or profoundly retarded (Bachman, 1972; van Velzen, 1975), and in those diagnosed as autistic (Rimland, 1964) or schizophrenic (Green, 1967; Shodell & Reiter, 1968). It is also observed in diverse other psychiatric populations (Ferrence, Jarvis, Johnson, & Whitehead, 1975; Lester, 1972b; Simpson, 1976), prisoners (Yaroshevsky, 1975), and the elderly (Kastenbaum & Mishara, 1971). Some of the most common forms of self-injurious behavior are head-banging, beating the head and face, scratching the body and face, and biting various parts of the body (van Velzen, 1975). More complex forms of self-injurious behavior may include cutting the body with implements (Ferrence *et al.*, 1975; Simpson, 1976; van Velzen, 1975).

The damage produced varies considerably. Some individuals behave in this manner only sporadically, and consequently produce only minor lesions and bruising. Others show exceedingly high levels of self-injury. For example, Lovaas and Simmons (1969) reported an individual showing 2750 hits to the head in a $1\frac{1}{2}$-hour period, while deCatanzaro and Baldwin (1978)

reported about 1000 head-hits per 15-minute sampling period. In many chronic cases, self-injury constitutes almost the entire behavioral repertoire of an individual (Bachman, 1972). Many individuals exhibit multiple forms of self-injury (Bryson, Sekati, Nyhan, & Fish, 1971; Duker, 1975; Paul & Miller, 1971; Romanczyk & Goren, 1975; Smeets, 1970) and commence a second form when the first is suppressed (Bryson *et al.*, 1971). In individuals showing chronic self-injurious behavior, outcomes such as blindness, loss of limbs, concussion, severe bleeding, and other forms of permanent damage are common (Bachman, 1972). Individuals producing more serious damage are usually kept physically restrained in institutions, with self-injurious behavior often beginning as soon as restraints are removed (Bachman, 1972; Bucher & Lovaas, 1968; deCatanzaro & Baldwin, 1978).

In its most severe form, such self-injury is clearly life-threatening. A series of head-hits or head-bangs endangers very vulnerable parts of the body, while self-scratching or self-biting are conducive to hemorrhage. In most chronic cases, severe damage or death is probably prevented only by institutional care and physical restraints which limit limb and body movement (Bachman, 1972; deCatanzaro & Baldwin, 1978). Current evidence indicates that self-injurious behavior frequently develops early in life. Most clinical reports indicate that human self-injurious behavior begins within 1-3 years of birth and commonly within the first year of life (Lester, 1972b).

The etiology of such self-injury remains poorly understood, primarily because of insufficient experimentation and systematic observation in the area. The paucity of reliable data may be attributable to the fact that the behavior is restricted to a small segment of the population. While there is a growing body of clinical literature on treatment of established self-injurious behavior, there is a particular lack of information concerning the preclinical development. This behavior may deserve more intensive study, however, since an understanding of its etiology may shed light not only on it but also on other self-destructive behavior.

Conclusions

It should be clear that self-damaging and self-destructive behavior are quite common in the current human population. This is true despite the fact that most human behavior acts in a self-preserving manner, and despite strong selective pressures that apparently should have acted to prevent self-destructiveness. Because such behavior is not uncommon, it presents a major challenge for current theories of human behavior.

Particular emphasis will be given in the subsequent chapters to discrete

successful acts of suicide, because these present the most unequivocal form of self-destructiveness. Other, less clear forms of self-damaging behavior will then be discussed to the extent that they extend the theory. Self-injurious behavior will be considered in detail because it is clearly life-threatening, it may elucidate some of the general issues involved in self-destructiveness, and it is in need of reinterpretation in light of a review of current evidence.

3

Historical and Cross-Cultural Perspective

Much of the best data on suicide and self-injury come from modern industrial societies where relatively careful records are kept concerning causes of death. But it is important for a sociobiological perspective also to have some understanding of the historical and cross-cultural incidence of self-destructiveness. We need to understand potential cultural determinants and to specify the ecological conditions conducive to such behavior. An understanding of the ecology of self-destructiveness will particularly provide some clues as to the adaptive significance of such behavior.

There are, unfortunately, several problems inherent in attempting to define the historical and cross-cultural incidence of self-destructiveness. First, the only relevant data concern suicide. Second, outside of technologically developed countries, the data sources may be weak. Instead of official and clinical records, we occasionally have only anecdote and historical writing of unknown reliability. In some cases, separating cultural mythology from accurate recounting of events is not possible. Furthermore, evidence is frequently second-hand or even more indirect, and is affected by the recounter's attribution of motives to acts performed by others. It is difficult to separate inference from description in anecdotal accounts of suicides in other countries. These problems are compounded when we attempt to make comparisons among cultures, since there may be unknown differential biases. Nevertheless, some excellent research has been conducted on the incidence and ecology of suicide in primitive cultures, and the historical record appears to be clear and consistent. Despite some methodological problems, the available data should involve at least some degree of accuracy and are worth reviewing as the best information available at this point.

The History of Suicide

It appears that suicide has occurred at least as long as human beings have kept written accounts of their history. Historical writing from literate early civilizations provides some records of the incidence of suicide and of attitudes toward it. Many of these writings are religious in nature and are more concerned with the ethics of suicide than with accurately portraying its incidence and social ecology. Although such a moralistic approach is quite separate from our interest here, some insights into the extent, form, and characteristics of earlier suicides are provided. Indeed, to quote Dublin (1963), "the very existence of a moral attitude, whether of approval or of condemnation, indicates that suicide is more or less common [p. 84]." Good reviews of suicide in ancient civilization are provided by Choron (1972), Dublin (1963), Farberow (1972), and Rosen (1971). Older but still serviceable reviews are those of Fedden (1938), Lisle (1856), O'Dea (1882), and Westermarck (1908).

Choron (1972) suggests that the first known document dealing with suicide is an Egyptian writing known as *Dispute over Suicide*. A man tiring of life, because of a series of misfortunes, debates with his soul whether to hold onto life and seek its pleasures or to commit suicide. Death becomes irresistable because of the social isolation and loneliness that the man experiences.

Suicide appears to have been quite common in Greek and Roman civilizations. It was mentioned with some admiration in ancient legends and in Homer, opposed by Pythagoras and other early philosophers, and actively encouraged by the Cynics, the Stoics, and the Epicureans (Dublin, 1963). Honor suicides (to avoid capture, slavery, and murder) appear to have been frequent among the Greeks, the Romans, and their neighbors. For example, after the capture of Athens in 322 B.C., Demosthenes took poison to avoid falling into Macedonian hands. Similarly, Hannibal the Carthaginian committed suicide by poison rather than be placed in the hands of the Romans. A famous suicide is that of Cato, who stabbed himself as Caesar, defeat, and certain slavery approached. Suicide in old age and sickness was also frequent and generally acceptable (Farberow, 1972). Cases in mentally disordered persons may also have been common, as exemplified by the suicide of Cleomenes, king of Sparta, described by Herodotus (Rosen, 1971). Hippocrates notes that young maidens afflicted with menstrual problems and accompanying mental disorders were commonly suicidal. Suicide by a widow following her husband's death was also not unknown. An example is that of Dido, who stabbed herself on her husband's funeral pyre.

Among the Jews, suicide was apparently rare, which may be consistent with the current low rates of suicide in Israel (see Table 2.1 on p. 14). Six in-

stances are cited in the Old Testament, without any accompanying moral judgment. Samson is said to have killed himself in the process of killing the Philistines; Saul fell upon his sword after defeat in battle to avoid the ignominy of capture; Saul's armor bearer followed Saul's example; Abimelech purportedly killed himself after being mortally wounded by a stone so that his murder would not be attributed to a woman; Atipophael hanged himself when his betrayal of David failed; Zimri burned himself to death following capture of the city in which he was besieged. In the New Testament, the only reported suicide is that of Judas Iscariot, who hanged himself. In the Talmud, reports of suicide are more common. The fundamental position of Jewish law was that respect should not be paid to the memory of the deceased although the person's family should be comforted (Dublin, 1963). Despite a general infrequency of individual suicides among Jews, there were reportedly some instances of mass suicide, especially when persecution was unusually intense. In 73 A.D., 960 persons are said to have killed themselves in the fortress of Masada, when capture by the Romans, with ensuing slaughter of men, rape of women, and enslavement of children, was inevitable. In 1095 in France, many Jews are said to have killed themselves to escape torture; 500 committed suicide in York in 1190 to escape oppression, while several Jews may have suicided in Europe during the plague epidemics of the fourteenth century because they were treated as scapegoats (O'Dea, 1882).

Among the early Christians, suicide may have been common, especially in consequence of severe persecution, and it may have been viewed quite favorably as martyrdom (O'Dea, 1882). Augustinus (1950) in the fourth century A.D. denounced suicide as a sin, which subsequently became the prevailing Christian attitude. Thomas Aquinas (1947) in the thirteenth century further promoted this view, which may have helped to foster the practicing of indignities against the corpses of suicides during the Middle Ages.

Suicide was frequently discussed in religious writings from India, and Thakur (1963) has provided a thorough review of this literature. The Brahmins, for example, viewed suicide quite favorably, suggesting that it provided a passport to heaven. Although suicide occurred in a variety of situations, one particularly conspicuous form of suicide was suttee, in which a widow would kill herself following the death of her husband. This practice was apparently quite common in parts of the Orient from the time of Alexander the Great (Rosen, 1971) or even as early as 1000 B.C. (Thakur, 1963), and was frequent until quite recently (Venkoba Rao, 1975). It varied in character in different times and places; often the women would plunge herself into the flames of her husband's funeral pyre, although self-stabbing and other methods may have been more common. The act was often institutionalized, in that pressure or coercion to perform it was exerted by others; in

such cases we might not classify the act as true suicide. In other localities or times this act was apparently voluntary, and by no means a universal response to a husband's death.

In other parts of the Orient, suicide was also apparently common throughout known history. Suicide was held in esteem in Buddhist teachings (Dublin, 1963). In China, suicide after defeat in battle, after death of a husband, in insolvency, or in dishonor was viewed favorably. In Japan, suicide may have been fairly widespread (Iga & Tatai, 1975; Seward, 1968). The act of hara-kiri was ritualized and institutionalized; it was made compulsory as a form of punishment for those of noble rank, allowing them to die by their own hand rather than at the hand of an executioner. Such compelled acts may again be beyond the definition of suicide we are employing here. Hara-kiri also was frequent as a voluntary act, occurring in despair, dishonor, or other misfortune (Iga & Tatai, 1975).

In the teachings of Islam, suicide has been condemned with consistency and severity, being viewed as unacceptable in any circumstance (Farberow, 1972; Thakur, 1963). The Koran suggests that it is not for any soul to die, save by God's permission, and that human beings should not be dissatisfied with their lots because God has ordained their destinies.

Suicide in Primitive Cultures

Cultural anthropologists have provided us with some data on the incidence of suicide in primitive tribes as they existed in the nineteenth and twentieth centuries. Although it has often been concluded that suicide is a product of civilization or modern industrial society and that it is rare among more primitive peoples, there is now substantial and reasonably reliable evidence that suicide is found in numerous primitive tribes from diverse parts of the globe.

Steinmetz (1894) reviewed nineteenth century anthropological data collecting several "instances of suicide among primitive peoples, which are distributed as follows: Polar peoples, 5; North American Indians, 14; South American Indians, 2; Bedouins, 2; peoples of the Caucasus, 3; native races of British India, 2; Melanesians, 4; Micronesians, 2; Polynesians, 4; Indonesians, 5 [p. 53]." He expressed the opinion that suicide was most frequent among the Hyperboreans and the North American Indians. However, he states that consultations of a relatively great body of authorities showed that suicide is unknown among the Australian and wilder South American peoples, although he suggested that this might be deceptive and based on incomplete or biased evidence. Steinmetz actually concluded that there is "a greater propensity to suicide among savage than among civilized peoples [p. 53]."

Westermarck (1908) argued that among the "lower savages—the Yahgans of Tierra del Fuego, the Andaman Islanders, and various Australian tribes [p. 12]" suicide is unknown. This was based primarily on interviews of tribesmen; Westermarck quotes Sir G. Grey's discussion of the natives of western and central Australia, "Whenever I have interrogated them on this point, they have invariably laughed at me, and treated my questions as a joke [p. 12]." Like Steinmetz, however, Westermarck discussed several instances of suicide among "higher savages."

Malinowski (1926) reported that Trobriand Islanders had two ways of committing suicide; the first form involved jumping from the top of a palm tree, the second consumption of a fatal poison taken from the gall bladder of the globefish. He reported that these two forms of behavior generally occur when an individual had reached some intolerable, inescapable situation. Often, this intolerable situation involved some transgression of tribal custom. For example, Malinowski cites one case where a 16-year-old youth plunged to his death when publicly accused of breaking the tribe's rules on exogamy through an involvement with his first cousin. Malinowski's observations are said to have led other anthropologists to reconsider the concept of suicide among primitive cultures (Gibbs, 1957).

Firth (1961) stated that the residents of Tikopia, a Polynesian community in the Western Pacific, show a relatively high suicide rate, as estimated from a sample of deaths between 1929 and 1951. Through self-hanging or self-drowning, the rate was 53 per 100,000 living population per year. There was also a very large number of deaths due to canoe-voyaging in the open sea, which Firth believed was in some instances a mode of suicide. Including only the less equivocal suicides through this mode raised the rate to between 60 and 70 per 100,000 population per year.

Elwin (1943) reported on suicide in the Maria, an aboriginal tribe of central India. He estimated an average annual rate of 5.3 per 100,000 from 1931-1940. The rate for the same period in an adjacent tribe, the Ghotul Muria, was 2.2; for other populations also found in what was then the jurisdictional region of Bastar State the rate was 3.6. Of 245 cases recorded in all tribes in Bastar State in that period, 214 were committed by hanging, 15 by drowning, 9 by poisoning, 1 by cutting the throat, and 6 by means not fully reported. The female rates in the Maria appeared to be approximately equal to those of males. The highest rates in the Maria were in early adulthood (ages 15 to 25) and after age 40.

Suicide has also been reported in Amerindians, with rates and circumstances apparently varying among the different tribes. Devereux (1961) suggested that numerous suicides occurred in Amerindian tribes when they were placed on reservations. In his report on the Mohave, he points out that more men than women commit suicide, and that frequent causes are difficulties with members of the opposite sex, illness, insults, and accusations.

The methods employed include hanging, shooting, stabbing, drowning, suffocating, and datura poisoning. Devereux reports that suicide is common despite the culture's condemnation of the act. Webb and Willard (1975), in reviewing several later studies of Amerindians, estimate recent annual rates of 100 per 100,000 among the Shoshone Indians, 50 per 100,000 among the White Mountain Apache, and 8 per 100,000 among the Navajo. They suggest that the Dakota and Cheyenne Indians do not commit suicide as such, but do often place themselves in high-risk situations. Among the Pueblo groups, suicide rates have varied considerably, depending on time and place; some of these cases appear to be related to acculturation stress. Of course, many of these recent rates may not necessarily be reflective of rates prior to influence from white populations.

Rasmussen (1931) reported that the custom among Netsilik Eskimos of Greenland was for the elderly and disabled to relieve their relatives of a burden by committing suicide. Weyer (1932) similarly reported the following:

> On King William Island, old folks no longer able to provide for themselves generally hang themselves. Among the Iglulik Eskimos suicide by hanging or drowning is rather common. The act must be performed while the hut is empty and a lamp must be left burning so that one entering will see the body. Suicide is stated to be fairly common among the Koksoagmiut, south of Hudson Strait; remorse and disappointed love are the only causes, death being sought either by strangulation, by pitching one's self over a cliff, or by shooting. Also, the Tahagmiut to the west not infrequently commit suicide, strangulation and shooting being the common methods. A native of Angmagasalik will throw himself into the sea, prompted by the admonition from his relatives that he has nothing to live for. The Copper Eskimos, however, resort to suicide but rarely, according to Jenness. This observer remembers hearing of only one case and that was due not to any morbid weariness of life, but to terror of the revenge that might be expected for a crime that the man had committed [p. 248].

Later, Leighton and Hughes (1955) discussed suicide with older Yuit Eskimos on St. Laurence Island, Alaska. From this limited data base they noted that male suicides were more common than those of females.

De Cieza de Léon (1959), writing in the sixteenth century, reported a number of suicides by hanging among the Incas and other South American Indians. Many of these were precipitated by fear of conquest.

Suicide has also been reported to occur among Africans. Westermarck (1908) suggested that it was quite common among the recently captured during the slave-trading periods. Some of the most thorough anthropological data on suicide are reported in a book edited by Bohannan (1960). Bohannan and his collaborators used thorough police files kept by the British during the 1940s and 1950s as a principal source of information. On the basis of these data, suicide rates would seem to be moderate to low relative to those of developed nations, although in most cases the computation of rates is more

difficult and perhaps less accurate than in record-keeping countries. However, in Fallers and Fallers's (1960) chapter on the Soga of southeastern Uganda, a mean annual rate of 7.0 per 100,000 living population could be estimated from fairly thorough records of 1952-1954. Of 100 suicides, 96 were by hanging, with the majority of cases in men (see Table 3.1). Lafontaine (1960) similarly reported a high rate among the Gisu, who say that, "A person commits suicide if he finds too much trouble [p. 110]." Of 68 Gisu cases, 64 involved hanging, 1 stabbing, 1 drowning, 1 setting fire to the house, and 1 jumping over a cliff. Suicide among the Gisu was somewhat more common among men than women. In Table 3.2 are given the ages of Soga and Gisu suicides; unfortunately this does not provide a rate based on population in each age bracket.

Also in Bohannan's (1960) book, suicide was reported to be quite frequent among the Nyoro in Uganda. Beattie (1960) recorded 61 cases from 1946 to 1955 from coroner's or police files, despite the fact that the Nyoro express abhorrence for and strong moral disapproval of suicide. In more than 90% of cases, death was by hanging from a house beam or tree; other cases involved self-stabbing or self-burning. Cases of suicide were also reported by Bohannan among the Bantu Kavirondo of Kenya, the Luo of Kenya (G.M.

Table 3.1
Sex and Suicide in African Tribes [a]

	Percentages			
	Luo	Nyoro	Gisu	Soga
Male	41	61	59	69
Female	59	39	41	31

[a] Source: Bohannan, 1960, p. 261. Reprinted by permission of Princeton University Press.

Table 3.2
Suicides among the Soga and Gisu by Age and Sex [a]

	Soga suicides		Gisu suicides	
Age	Men	Women	Men	Women
Under 21	3	6	7	0
21-35	23	35	11	6
36-50	25	31	6	3
51-65	6	12	3	3
Over 65	4	6	5	0
Adult	8	10	X	X

[a]Source: LaFontaine, 1975, p. 86. Reprinted by permission of Oxford University Press.

Wilson, 1960), and less frequently among the Alur of Uganda (Southall, 1960); in all of these cases, however, police records were incomplete or lacking. Bohannan reported that among the Tiv of central Nigeria suicide may be relatively rare; cases that did occur were unusual for Africa in that they all involved self-stabbing rather than hanging.

It seems clear that suicide is by no means restricted to modern, developed countries. Indeed, it occurs with some frequency among most primitive tribes or less technologically developed societies throughout the world. Although many of the reports are from cultures that have been affected by intervention from more developed cultures, it is unlikely that this is entirely responsible for the occurrence of suicide. First, many of the reports are from cultures, such as the Eskimos or Trobriand Islanders, that were not greatly disturbed by colonialists. Second, the methods are often culture-specific or different from those of colonialists. For example, among the African tribes discussed by Bohannan and his collaborators, the most common method of committing suicide was hanging, whereas Europeans in the area apparently most commonly used firearms. Also, Fallers and Fallers reported that those areas where the Soga had the least contact with Europeans were the areas where suicide was most common. It seems likely that suicide was reasonably common in primitive cultures long before they were influenced by Europeans and other outsiders. Nonetheless, the frequency of suicide at times may have been greatly increased by stresses caused by outside intervention, such as during the slave trade in Africa or among Amerindians after placement on reservations.

Modern Ethnic, Racial, and Cultural Differences

The advent of thorough record keeping on causes of death in industrial countries, taken with some fairly careful sociological studies of suicide, has made possible comparisons of suicide rates over time and across cultures. We must, however, consider that extratemporal and cross-cultural comparisons are limited by differences in the degree of accuracy of the record-keeping. In Table 3.3 are presented data from various industrial countries obtained in 1910-1914, 1926-1930, and 1960. Recent differences in rates of suicide among different countries (cf. Table 2.1) appear to be remarkably consistent with differences earlier in this century. Despite the common notion that suicide rates may be increasing in recent years, it appears that such rates are generally stable. This stability is quite remarkable, given potential changes in statistical biases and major social changes wrought by World Wars I and II. The suicide rates are also quite similar to those reported in the nineteenth century, where these are available. For example, Littlejohn (1910-1911) reports annual suicide rates of 25.1 for Denmark, 23.9 for Switzerland, 18.0

Table 3.3
Changes in the Suicide Death Rate in Principal Countries of the World per 100,000 Living Population [a]

Country	1910-1914	1926-1930	1960
United States (original registration states)	15.4	15.0	10.6 [b]
England and Wales	9.9	12.3	11.2
Scotland	5.7	9.8	7.8
Irish Free State	3.2	3.3	3.0
Holland	6.2	7.1	6.6
Sweden	17.6	14.5	17.4
Norway	6.0	6.5	6.4
Denmark	18.6	16.8	20.3
Finland	9.6	16.8 [c]	20.4
France	22.2	19.1 [d]	15.9
Belgium	14.0 [e]	15.8	14.6
Germany	21.9	25.9	18.8 [f]
Austria	25.7	35.3	23.0
Switzerland	23.7	25.3	19.0
Italy	8.5	9.6	6.3
Spain	5.1 [g]	4.7	5.2 [h]
Australia	12.8	12.2	10.6
New Zealand	12.1	13.9	9.7
South Africa	10.5 [i]	11.2 [c]	12.2 [h]
Japan	19.0	20.6	21.3

[a] Source: Dublin, 1963, p. 211. Reprinted by permission of John Wiley & Sons.
[b] Total United States.
[c] 1926-1929.
[d] 1926-1928.
[e] 1910-1913.
[f] Federal Republic of Germany.
[g] 1911-1914.
[h] 1959.
[i] 1912-1914.

for France, 6.9 for Norway, 7.5 for England and Wales, and 1.7 for Ireland during 1878-1882.

Interestingly, suicide rates among immigrants to the United States in the twentieth century follow the same relative patterns as found when we compare such rates in their respective countries of birth, although the immigrants' rates are generally higher. In Table 3.4 are shown data from foreign-born individuals in the United States in 1959. Central Europeans show the highest rates, as was true in Tables 2.1 (p. 14) and 3.3.

It has often been contended (e.g., Dublin, 1963) that religiosity and taboos against suicide may account for the variance in rates in different countries. Particularly, it has been argued that rates are generally low in Roman Catholic countries and in Moslem countries due to strictures on the part of

Table 3.4
Suicide Rates among Foreign-born Individuals in the United States, 1959[a]

Country of birth	Male	Female	Total
England and Wales	33.7	9.1	19.2
Ireland	17.9	4.4	9.8
Norway	42.5	4.0	23.7
Sweden	56.7	11.0	34.2
Germany	44.4	11.4	25.7
Poland	39.3	11.7	25.2
Czechoslovakia	56.2	10.6	31.5
Austria	57.8	11.4	32.5
USSR	47.0	14.4	30.2
Italy	29.7	5.4	18.2
Canada	31.0	7.5	17.5
Mexico	12.3	2.6	7.9

[a] Source: Adapted from Dublin, 1963, pp. 216-217. Reprinted by permission of John Wiley & Sons.

the Church or Koran against suicide. While rates are low in predominantly Roman Catholic countries such as Ireland, Spain, and Italy, rates are quite high in countries such as Austria and France where a majority of people are also of that faith. The international differences in rates might equally, if not more accurately, be attributed to differences in the level of industrialization in various countries; highly industrial countries show the highest suicide rates. Furthermore, as discussed in Chapter 2, low rates among some countries with taboos against suicide may partly reflect avoidance of classifying deaths as suicide.

Despite many similarities in the nature of suicide in different cultures, there are some aspects that may be specific to particular cultures. In Israel, for example, unlike most other cultures, the rate of suicide among women is almost equal to that among men (Headley, 1975), which may relate to the importance of women in Jewish culture. There are also differences in suicide patterns among the various subgroupings in Israeli society. Eastern European Israelis, particularly those from Poland and Romania, show the highest rates, whereas African- and Asian-born Jews show the lowest suicide rate but the highest attempt rate. The method of self-burning is quite common among African and Asian Israelis, especially among women, but uncommon among European Israelis. Overall, suicide is an unacceptable act that Israelis do not even like to discuss (Headley, 1975); nonetheless, the act is not infrequent.

In Japan, suicide is a common and respectable act (see DeVos, 1964, 1968; Iga & Tatai, 1975). While suicide rates generally increase with age in Western countries, the age distribution for Japan is bimodal. For males, the rate for 1952-1954 was a high 60 per 100,000 in ages 20-24, being con-

siderably lower in middle age, then reaching a rate of 96 for ages 70 and over (Iga & Tatai, 1975). The female rate is almost equal to the male rate, being the highest among modern nations for females; the peaks among females are similar to those among males. The ratio of attempted suicide to successful suicide is 1:1 for young Japanese, but successful suicide rates are much higher than rates for attempted suicide among the elderly. Hanging was the most common method until 1950, with pills now being most common; hara-kiri is now quite uncommon.

Murphy (1954) studied suicide in Singapore, where the population was 76% Chinese, 13% Malay, 8% Indian, and 3% European. Malays were found to have exceptionally low rates for both sexes and at all ages, which Murphy suggested might be related to low achievement orientation in that culture. Suicide was prevalent, however, in the three other ethnic groups and showed a fairly constant pattern over the years. There was a high rate in younger ages among the Chinese in Singapore, and the young female rate almost approximated the rate in young men. Murphy also found consistently different rates among Chinese from discrete regional dialect groups. Rates also appeared to be lower in areas of homogeneous populations living in close contact with one another as compared to areas of mixed populations. Yap (1958) studied suicide in Hong Kong. Yap suggested that suicide-producing stresses fall with special severity on Chinese youth, women as well as men, in that traditional Chinese culture puts great emphasis on respect for the aged. These patterns, however, appeared to be undergoing transitions toward the Western pattern, as suicide among the aged was increasing in frequency.

Within the United States there is a curious and consistent difference in suicide rates between black and white populations; black suicide is substantially less frequent (Swanson & Breed, 1976). Such a difference may be contrary to expectation, in that blacks generally experience a poorer standard of living than whites. Indeed, in Western culture suicide is highest among the divorced and separated, Protestants, persons in poor physical health, the unemployed, and those living in cities; proportionately more blacks fall into these categories than do whites. Yet the rate among blacks is less than half that among whites (about 4.6 among blacks versus 11.3 among whites per 100,000 annually). Furthermore, although white suicide rates increase with age, the black rate is highest in ages 25-29, and declines steadily thereafter. Black males show a rate four times that of black females.

Interestingly, these low rates among blacks are concordant with the limited available data from Africa. As was discussed above, studies by Bohannan and collaborators (1960) indicated low to moderate suicide rates, depending on the tribe being considered. Suicide rates may be very low in some parts of Africa. Asuni (1962) reported rates in western Nigeria that may be the lowest reported from any part of the world from a careful survey. Asuni's study was

based on coroners' reports from 1957 to 1960 in an area with a population of $6\frac{3}{4}$million. The data are believed to be reasonably reliable, given a general fear of criminal charges which may follow unreported cases and because suicides tend to attract much publicity. The rates, which vary by locality, for the whole region average less than 1 per 100,000 population per year. There is a male-female ratio of 3.6:1, and hanging is by far the most common method.

Racial patterns in South Africa are also consistent with these trends. Meer (1976) has presented a very thorough set of statistics on suicide in the four official racial groupings in Durban, including annual data from 1924-1971. Table 3.5 gives mean rates for five successive decades during this period. The rate among Africans, despite their relative poverty, has been consistently lower than the rate among Whites, although there appears to be a steady increase during this century among Africans. The rate for the Indian population was consistently high, whereas the rate for the Coloured population was high but quite variable. The variability in the Coloured population may be attributable to the relatively small sample size. The sex ratios are also of interest, with a White male rate four times that of White females, equivalent rates for the sexes in Africans and Indians, and somewhat higher rates in females than males for Coloured populations (see Table 3.6). Methods also showed race and sex differences (see Table 3.7). Among African, Coloured, and Indian men, hanging was by far the most common method. Women in these three racial categories most commonly chose death by burning. Among White men, shooting was most common. White women most commonly employed poison; very rarely did they burn themselves, as did women of other races.

Table 3.5
Mean Annual Suicide Rates per 100,000 for Selected Intervals from 1924 to 1971 in Durban, South Africa[a]

Period	African	White	Coloured	Indian
1924-1931	3.8	19.4[b]	[c]	18.6
1932-1941	4.1	13.2[b]	10.6[d]	15.6
1942-1951	8.4	13.3	26.8	20.4
1952-1960[e]	10.6	12.9	4.0	13.3
1962-1971	14.8	18.9	17.3	15.4
1924-1971	8.6	15.3	16.1	16.6

[a] Source: From Meer, 1976, pp. 231-233. Reprinted by permission of Routledge & Kegan Paul Ltd.
[b] Whites include Coloureds up to 1940.
[c] Coloured rates not available.
[d] Based on 1940 and 1941.
[e] 1961 data not available.

Table 3.6
Mean Annual Suicide Rate per 100,000 in Durban, South Africa by Race and Sex from 1940 to 1960[a]

	African	White	Coloured	Indian
Men	9.2	23.1	9.2	16.0
Women	9.2	5.8	15.2	16.2

[a] Source: Meer, 1976, p. 236. Reprinted by permission of Routledge & Kegan Paul Ltd.

Table 3.7
Methods of Suicide by Percentage within Each Race-Sex Category, Durban, South Africa, 1962-1970[a]

	African		White		Coloured		Indian	
	Men	Women	Men	Women	Men	Women	Men	Women
Poison	3.7	1.1	16.7	46.6	13.6	11.1	19.3	22.2
Hanging	52.6	11.5	12.6	3.4	31.8	7.4	49.7	18.8
Burning	7.4	71.3	0.9	1.1	13.6	77.8	4.7	47.0
Shooting	0.0	0.0	35.1	22.7	9.1	0.0	1.2	0.9
Laceration	0.7	0.0	1.8	2.3	0.0	0.0	0.6	0.0
Drowning	10.4	6.9	2.7	1.1	22.8	3.7	17.5	6.8
Jumping	5.9	1.1	8.5	19.4	0.0	0.0	0.6	1.7
Electrocution	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0
Gassing	0.0	0.0	20.3	2.3	0.0	0.0	3.5	0.9
Moving vehicles	19.3	8.1	0.0	1.1	9.1	0.0	2.9	1.7

[a] Source: Adapted from Meer, 1976, pp. 279-280. Reprinted by permission of Routledge & Kegan Paul Ltd.

One other difference that is frequently cited is between urban and rural areas. Indeed, this was true in the early part of the twentieth century for the United States and remained true later in this century in many parts of Europe (Dublin, 1963). However, more recent data from the United States indicate that this trend no longer occurs (Linden & Breed, 1976). Suicide rates among rural males were equivalent to those among urban males as of 1960, while those among rural females were only very slightly lower than those among urban females.

Conclusions

It should be clear from this discussion that suicide is virtually a species-wide phenomenon. It occurs in diverse cultures throughout the world, and appears to have occurred as long as history has been recorded. Indeed, the anthropological data appear to indicate that suicide was not uncommon in preindustrial, preliterate, tribal cultures. There are, nevertheless, clear racial

and ethnic differences in suicide rates and other characteristics of the act; the racial and ethnic differences in rates appear to be consistent over time and across international boundaries.

Suicide occurs at some rate within almost all cultures, in spite of cultural condemnation or glorification of the act. Although rates may be lower, suicide occurs in Roman Catholic countries, in Israel, in Moslem countries, and among various African tribes, despite abhorrence for the act and often denigration of it in these cultures. It is not clear that religious or social sanctioning of the act is a critical determinant of its frequency, especially given the fact that very high rates can occur in countries such as Austria or Hungary, which are predominantly Roman Catholic. In any event, the order of causation in any correlation of suicide rate and prevailing social attitude toward suicide is unclear (see Chapter 11).

In most cultures, suicide is more common in men than women. The method of self-hanging is probably the most common method in the world; in industrialized countries this method is now often surpassed by the use of firearms and drugs.

Some of the greatest differences among various cultures may lie in attitudes toward suicide, in rituals performed subsequent to suicide, and in institutionalized forms of the act such as suttee and hara-kiri. Institutionalized suicide (see Farberow, 1972; Iga & Tatai, 1975; Malinowski, 1926; Venkoba Rao, 1975) may not clearly fit our definition of suicide because there is some compulsion to perform the act.

As will be discussed in later chapters, there is also reason to suspect that the motives for individual suicides are highly similar across cultures. This should become clear in discussing the social ecology of suicide and in attempting to identify ultimate evolutionary and sociobiological determinants of the act. Indeed, it will be argued that differences among cultures may be magnified by erroneously considering proximate cognitive motives as ultimate determinants, and by confusing social rituals surrounding the act with determinations of the act.

Given that suicide is almost ubiquitous in the human species, we are forced to consider how such an apparently maladaptive behavior has been allowed to exist by evolutionary contingencies. Given the likelihood that suicide has occurred for numerous generations, as evidenced by its occurrence in surviving nineteenth- and twentieth-century primitive cultures as well as throughout written history, natural selection should have had ample time to modulate if not eradicate its occurrence.

4

Self-Destructiveness in Other Species

Because suicidal behavior is almost ubiquitous across human cultures, we should inquire whether analogous forms of behavior are present in other animal species. The definition of *suicide* or *self-destruction* becomes even more difficult here, and by necessity is behavioral in nature. No notion of "intent" can enter into such discussions; we have no verbal expression of cognition with nonhuman species. Indeed, this underscores the problems with cognitive definitions of suicide discussed earlier. Not only are ascriptions of intent subjective and post hoc, but even where individuals verbally express intent we are not certain how well they understand the determinants of their own behavior nor how well the proximate cognitive variables relate to ultimate sociobiological determinants.

If the question is whether or not animals engage in behavior that facilitates their death, we must answer in the affirmative. Any time a rabbit forages where it is subject to predation, death may occur consequent to behavior. We would, however, surely wish to exclude this from our definition because the behavior is apparently oriented quite adaptively toward food acquisition. Accordingly, we would like to identify as self-destructive only behavior that is *directly* oriented toward or conducive to death. We wish to identify behavior whose most probable outcome and immediate function is to bring on the behaving organism's death.

W. J. Hamilton's (1980) response to my earlier article on the biology of suicide (deCatanzaro, 1980) has been most helpful in structuring my thinking on this topic. Hamilton suggested that among animals living in their natural ecological conditions, suicide-like behavior is exceedingly rare. Indeed, the available ethological evidence may support this contention. Some forms of animal behavior involving high risk of death for the behaving individual can

be identified, but these may at best be classified as semisuicidal or pseudosuicidal, since they differ substantially from most human forms of self-destruction. However, we should not prematurely conclude that suicide does not occur in other species. Animals in captivity or conditions unlike their natural habitat may display behavior that is clearly self-destructive in nature. We must also consider that true self-destructiveness might occur among nonhumans in forms that are difficult to discriminate from other forms of death.

"Suicide" among Social Insects

Some of the clearest examples of semisuicidal behavioral patterns are found among social insects. The patterns involve the organism engaging in behavior with an exceedingly high probability of death as the outcome. For example, a honeybee worker almost invariably dies as a consequence of stinging (Sakagami & Akahira, 1960). The barbed stinger remains embedded when the insects pull away from their victims, causing part of their viscera to be torn out to produce fatal injury. Members of the soldier castes of most species of termites and ants frequently place themselves in positions of extreme danger, in effect terminating their own lives (E. O. Wilson, 1971). It is believed that these forms of behavior can occur because they improve the fitness of reproducing individuals sharing the genes of the self-sacrificing individual (E. O. Wilson, 1971). The self-sacrificing individual is a non-reproducing member of a symbiotic colony. Its genetic complement is entirely represented in other, reproducing members of the colony. Consequently, the self-sacrificing behavior, to the extent that it furthers the biological fitness of the reproducing colony members, is adaptively oriented toward inclusive fitness. No reproductive potential is lost as a consequence of the self-sacrificing behavior; more likely, the behavior increases such potential. In a sense, the colony constitutes an individual organism because of the degree of gene sharing and cooperation among members; the behavior is oriented toward the colony's fitness.

Migration, Emigration, and Population Dispersion

Many animals make regular migrations among alternative ranges. Often, some mortality occurs due to the hazards involved, but such migrations are clearly adaptive in that they involve orientation toward fitness-supporting resources and away from depleted or seasonally unavailable resources. The long-distance migration of birds, whales, and insects may occasionally pro-

duce massive mortality because of imperfections in the adaptation; the general behavioral pattern to which this mortality is incidental, however, is clearly oriented toward improved fitness (W. J. Hamilton, 1980).

Many animals also make one-way migrations. Occasionally, this may involve movement to places in which they cannot survive. The reputed "mass-suicidal" behavior of the Norwegian lemming appears to be of this nature. Members of this species may emigrate in large numbers from areas where resources are scarce and population levels are high (Clough, 1965). Death may occasionally occur when major geographic barriers, such as cliffs or large bodies of water, are encountered. However, movement from an area of excessive competition and depleted resources may involve little loss of potential fitness; it may improve fitness to the extent that other areas are less densely populated and contain untapped resources. Some risk is entailed in the emigration, but the payoff is probably adequate to warrant this risk. It is not infrequently reported in the news media that large numbers of whales may beach themselves. Little is known about this phenomenon, although it may relate to migration, resource ecology, or pathological conditions. Population cycles are not uncommon in many other species. Insofar as the consequence of remaining in an environment without adequate food is certain death, emigration to places unknown, with all its risks, may be the optimal strategy for improving fitness. Caribbean lizards are known to leap into the open sea and swim when confronted with extremely hostile conditions, which involves great risk of death but a chance of survival in more favorable conditions on other islands (W. J. Hamilton, 1980).

Kin Selection and Parental Investment

There are cases in many species where individual will sacrifice their personal fitness for the fitness of related individuals (W. D. Hamilton, 1964). This may be especially true of parent-offspring interactions, where parents may act in manners that reduce their own lifespan while promoting the fitness of offspring (Trivers, 1972). W. J. Hamilton (1980) cites the example of some salmon species that die after making a one-way migration upstream to spawn. This behavior might be considered suicidal except that its adaptive value in propagating the behaving individual's genes is clearly evident. Similarly, in the ceratopogonid fly *Johannseniella nitida*, the male is eaten by the female immediately following copulation (E. O. Wilson, 1975); the male could be said to be committing suicide if not for the fact that his copulatory behavior propagates his genes. Also, any behavior that nurtures offspring or defends them from predation or other danger involves some expenditure of energy by parents and some potential reduction in the parents' longevity. In

extreme cases, death of the parent may be a necessary or likely consequence of some reproductive exercise. Such parental investment (Trivers, 1972) is outside of our definitions of suicide or self-destruction, however, insofar as the reproductive behavior serves the behaving organism's inclusive fitness by promoting the existence of its genes in future generations.

Self-Injury in Captivity and Experimental Conditions

Self-injurious behavior, very similar to that occurring in human psychiatric populations, has been reported in primates. Usually such behavior occurs in captivity or experimental conditions. Yerkes (1925) reported that behavior such as head-banging is frequent in young primates in stressful situations. Frieh (1942) found a number of cases of self-injury such as self-scratching in caged chimpanzees. There are several reports of self-injurious behavior, such as head-banging, self-scratching, and self-biting in primates reared in complete social isolation or partial social isolation (Cross & Harlow, 1965; Gluck & Sackett, 1974; Harlow & Griffin, 1965; Mason & Sponholz, 1963). Erwin, Mitchell, & Maple (1973) found that self-injury occurred in normally raised but caged rhesus monkeys in stressful situations that did not allow appropriate direction of aggression toward others. Under such laboratory conditions, self-injurious behavior can be persistent and is clearly life-threatening. It is unknown whether comparable self-injury occurs among primates in their natural habitats in times of severe stress.

Self-injury has been induced in other mammalian species through various physiological manipulations or placement in unusual environments. In cats, decerebration has induced persistent self-biting behavior (Hendrick, 1950). Similarly, temporal lobe lesions (Kluver & Bucy, 1939) and intervention in the caudate nucleus of the brain (Korten, Van Dorp, Hustinx, Scheres, & Rutten, 1975) have produced self-injurious behavior in nonhumans. In laboratory mice, middle ear infection (Harkness & Wagner, 1975) and treatment with the drug clonidine (Razzak, Fujiwara, & Ueki, 1975) have induced self-biting and other self-injury, while caffeine has induced similar behavior in the laboratory rat (Peters, 1967). Randrup & Munkvad (1969) have reported that high doses of central nervous system stimulants, such as amphetamines, will occasionally induce persistent, stereotypic self-injury in laboratory rats and other mammals. Melzack & Scott (1957) found that domestic dogs raised from weaning in social isolation show poor avoidance of aversive stimuli such as fire and shock, an effect also found in laboratory rats by Lore (1969). In all of these cases, the animals are clearly outside of their natural environment.

A Laboratory "Suicide Paradigm"

Schaeffer (1967) has conducted some rather unique experiments employing laboratory mice as subjects. He placed each subject into a chamber in which it could observe adjacent and distinctively marked areas, one of which was a "death" chamber and the other a "life" chamber. The subject observed the death of a mouse through high-voltage current in the death chamber, but observed no consequence to a mouse in the other chamber. When subsequently given a choice of entering either of the two chambers, mice tended to avoid the death chamber. Schaeffer has thus described an experimental context that might be used for the investigation of animal "suicide." However it does not appear that he has taken these experiments further to examine self-selection of death under various motivational conditions. For example, mice exposed to chronic inescapable stress might be examined in this context. Also, the relevance of behavior in this contrived laboratory setting to behavior in the natural habitat could be questioned.

The "Sudden-Death" Phenomenon

Richter (1957, 1958) conducted a number of experiments in which he found that rats exposed to inescapable stressors suddenly died without any obvious physiological cause. For example, he found that wild rats died within a few minutes of being placed in a swimming cylinder from which they could not escape. A rat is capable of swimming for very long periods of time, and the death was not attributable to drowning. Richter also found that wild rats occasionally died just when being handled by humans. Richter argued that it was the abolishment of all hope of escape, or hopelessness, that was conducive to death. This finding has been replicated by other researchers (see Binik, Theriault, & Shustack, 1977; Griffiths, 1960; Lynch & Katcher, 1974; Rosellini, Binik, & Seligman, 1976) within similar experimental circumstances. While this does not involve death induced by overt behavior, and consequently is not suicide, it may share features of human suicide in a fairly striking manner. It involves a cessation of life-preservation in a circumstance of inescapable stress or hopelessness, which in subsequent chapters will be argued to be the best characterization of human suicide.

Other Instances

The phototropism of moths and other insects may appear "suicidal" when the source of light is a flame or other very hot item (see Dawkins, 1980). Such a tropism has presumably evolved because it is adaptive when

displayed in the presence of natural sources of light. The introduction of artificial light sources by humans has created new environmental conditions for which these species are not fully adapted. Animals killed on human highways are in a similar circumstance.

One apparent case of suicidal behavior among chimpanzees was reported by Goodall (1979). This involved an 8-year-old chimpanzee becoming lethargic, ceasing eating, and dying following the death of his mother upon whom he was exceptionally dependent. Hence he may have hastened his own death by simply ceasing to maintain himself, although we do not know whether he had the skills to do so without interactions with his mother. It is interesting in this connection that behavioral conditions similar to human depression or despondency, involving apparent apathy and reductions in activity levels, have been reported as characterizing nonhuman primates when confronted with some major loss (see Harlow, 1974). Harlow argues that the inhibition of play and regression to infantile states characterize such "depression," and that there is a progression from protest to despair similar to that seen in humans following separation from normal maternal or social contact. As will be discussed in Chapter 5, human suicide usually occurs following severe depression or despondency; we consequently would profit from more research concerning any comparable affective states and behavior occurring in other primates. These affective states are particularly interesting in light of the reports, discussed above, of self-injurious behavior in primates in stressful situations, and in view of the relatively close relationship of these species to man.

Unfortunately, suicide-like behavior occurring in other species may be difficult to identify because of methodological and logical problems. For example, if an animal discontinues eating, drinking, and shelter-seeking behavior it will die. An observer might attribute such behavior to illness, despite the fact that any illness that may or may not be present would be inadequate to produce cessation of such life-supporting behavior. Similarly, an animal may fail to avoid a predator to the full extent of its ability, perhaps because it is old, ill, or stressed in some manner. An observer might attribute such an animal's death to the skill of the predator or some apparent weakness of the prey. The observer could not, however, assess the extent to which the prey's attempt to escape was as great as it might be. An interesting case in this respect is the behavior of certain butterfly species in the presence of predators. Senescent adults (Blest, 1963) or those with lethal internal parasites (Shapiro, 1976) may actually approach predators. Blest has argued that this may, in the case of distasteful and uniquely colored moths, indoctrinate predators to avoid eating other members of the species. Poor predator-avoidance displayed by weak members of any species, particularly social species, may also keep predators from attacking more vigorous and reproductively capable

members. However, the extent that such group benefit, rather than the weakness itself, is responsible for poor predator-avoidance is quite difficult to determine.

Conclusions

In summary, it appears that suicide-like behavior in nonhumans is relatively uncommon. There are instances in which one of the consequences of some frequently demonstrated behavior is the death of the behaving animal. However, in almost all such cases some clear adaptive value, such as the animal's reproduction, is present. There are also cases where animals enter circumstances where there is a high probability of death; in these cases the animal most commonly is departing from circumstances where death is even more likely. Captive animals, those placed in highly unnatural environments, or those subjected to unnatural physiological manipulations may show life-threatening behavior; comparable forms of behavior have not frequently been observed in intact animals living in their natural ecological conditions. It is also possible that insufficient ethological data have been obtained to document instances of self-destructive behavior or that methodological problems preclude the identification of such behavior.

On the whole, it would appear that there are few animal homologues of human suicide. Self-destruction of such a direct and unequivocal nature seems to be characteristic of the human species. The lack of phylogenic continuity of this behavior may not be complete; self-injury in times of severe stress does occur in primates; the relationship of self-injury and suicide will be discussed in a later chapter. But the not infrequent occurrence of suicide in both primitive and modern human societies suggests that factors unique to humans may be especially important determinants of suicidal behavior.

5

Biological Fitness and the Social Ecology of Suicide

So far, I have considered the problem of self-destruction as the antithesis of almost all other forms of behavior. It is apparently contrary to natural selection, yet it is a common mode of death virtually throughout the human species. It occurs at an appreciable rate in almost all human cultures, with the possible exception of some of the very most primitive and the least socially organized. Analogous behavior is not common in other species, with a few possible exceptions. I would like now to begin to explain self-destructiveness in a sociobiological framework. A consideration of the social-ecological status of human suicides and their relationship to biological fitness may elucidate the anomaly of suicide. The majority of suicides may actually have relatively little negative impact on the population gene pool. That is, suicide may in most cases not actually reduce the frequency of the suicidal individual's genes in the gene pool. This is because it predominantly occurs in individuals with low biological fitness. Individuals committing suicide may have relatively little residual capacity to advance the existence of their genotype in future generations.

Proximate Motivation of Suicide

Let us first consider proximate motives for suicide, or the most obvious and immediate precipitating events. In some cases these are the motives reported verbally by the suicidal individuals themselves. There are, of course, several difficulties with reports of proximate motives for suicide. First, there is the common tendency for observers to impute motives on the basis of their own subjective biases. Separating fact from interpretation may consequently

be difficult, particularly when examining the psychiatric literature in which theoretical bias often appears to obscure the data. Information concerning personal histories of suicides is also inevitably incomplete. Furthermore, in the anthropological and sociological literatures, there seems to be a concentration on rituals surrounding suicide and attitudes toward it rather than on its long-term societal impact or on its proximate determinants. By necessity, my analysis here will contain some of these problems, being post hoc and incomplete in nature. However, a fairly consistent picture can be derived through a broad examination of the literature.

In this discussion, I do not mean to belittle individual differences in motivation for suicide, and will discuss at a later point how causation may be multifarious and diverse. However, at some level of analysis, the causation of self-destructiveness must be unitary. This is suggested by the fact that suicide is almost limited to the human species; some unique aspect of this species could account for its occurrence. I would like to suggest that the social ecology of human suicide and its relationship to selective pressures provide the first major clue to an understanding of the causation of suicide.

Desperation, Hopelessness, and Adaptation

There is growing agreement in the literature that suicide relates to coping difficulties in almost every case of its occurrence. Suicide is widely considered to be an act of "desperation." It occurs in extreme circumstances (Lingens, 1972), particularly where an individual believes he or she is incapable of coping with present circumstances and expects little improvement in the future (Bogard, 1971). Farber (1968) has argued that suicide occurs when people envision not only the present but also the future as negative and unacceptable. Farber asserts that suicide is unlikely when people anticipate acceptable life conditions and have a sense of competence, but likely when acceptable circumstances are seriously and permanently threatened. Choron (1972) argues that no matter what the motives and causes of suicide may be in a given case, suicidal individuals usually complain that their lives have lost meaning and are no longer worth living.

Beck, Kovacs, and Weissman (1975) have presented data suggesting that "hopelessness" is highly correlated with true suicidal intent, being a better predictor of suicide than "depression." Depression may be viewed as a common, potentially transitory state that accompanies some loss to the individual or impairment of fitness. Hopelessness, however, may involve a loss of or impairment to fitness that is permanent. Individuals see themselves as failing to cope not only in the present but also in all foreseeable future circumstances.

Accordingly, human suicide occurs in individuals experiencing extreme

difficulties in coping and expecting little improvement in future. Recall the assumptions, expounded in Chapter 1, that coping behavior is that which promotes the continued existence of the behaving individual's genes. If individuals are unable to cope effectively, it follows that they are unable to advance or propagate their genes. Individuals experiencing extreme and permanent difficulties in adapting may have little residual capacity to influence the welfare of their genes in future generations. Consequently, if such an individual were to die, there might be little impact on the population gene pool. The individual's death would effectively not extract genes from the gene pool, at least insofar as he or she had little residual reproductive and productive ability. Conversely, suicide may be quite rare in well-adapted individuals with continuing reproductive and productive prospects. The death of a well-adapted individual would clearly affect the frequency of genes in the population gene pool because residual reproductive and productive capacity would be lost. The first major clue in the sociobiological analysis of suicide, then, is that suicide often occurs where it does not truly delete the individual's genes from the population gene pool.

Cross-cultural Perspective

I would like now to prove this assertion in detail. In modern Western cultures, the coping difficulties precipitating suicide may be diverse in nature, but may converge insofar as they are each sufficiently severe to impede effective promotion of the individual's inclusive fitness. For example, suicide frequently relates to economic hardship, commonly occurring in the unemployed or those that have suffered some severe economic loss (McCulloch & Philip, 1972). Severe economic hardship may reduce the individual's capacity to reproduce, nurture offspring, or otherwise behave in a productive manner that promotes inclusive fitness. Suicide is also very common among the terminally ill, the elderly, and those with physical disabilities (Dorpat, Anderson, & Ripley, 1968; McCulloch & Philip, 1972; Weiss, 1968). Severe impairments to health are likely to preclude reproductive activity and to reduce the individual's ability to work toward the benefit of reproducing kin.

Our best indications are that this generalization also holds for suicide in other cultures. Farberow (1972) outlines four motivations of suicide in classical civilizations: (*a*) to preserve honor, (*b*) to avoid pain and ignominy, (*c*) in bereavement from loss of a loved one, and (*d*) for a patriotic cause. Rosen (1971) similarly points to suicide in illness and old age, in the face of slavery or torture, following death of a spouse, or in madness. Those that are ill, aging, insane, or facing slavery or murder are clearly in a position of low potential future fitness; those having lost a spouse have suffered a loss in

their capacity to reproduce. Patriotic suicide, motivated solely for benefit of country, may involve special considerations that will be discussed in Chapters 9 and 15.

Westermarck (1908) suggested that the "causes which, among savages, lead to suicide are manifold: disappointed love or jealousy; illness or old age; grief over the death of a child, a husband, or a wife; fear of punishment; slavery or brutal treatment by a husband; remorse, shame, or wounded pride; anger or revenge [p. 13]." Similarly, Malinowski (1926) spoke of suicide among Trobriand Islanders when they had reached an "intolerable impasse" or "unbearable situation." Leighton and Hughes (1955) stated that the most common motives for suicide among Eskimos were suffering due to sickness, a feeling of uselessness, and grief due to death of a loved one. Each of these motives can be construed as involving some major loss of biological fitness for the suicidal individual: Disappointed love involves a loss of reproductive status, as does death of a spouse or child; illness, old age, slavery, and adverse treatment involve an obvious impairment of fitness; individuals in situations requiring revenge have generally suffered some major loss themselves; and so on.

Table 5.1 gives a summary of apparent causes of suicide in Bastar State in India. In Table 5.2 are presented apparent causes in two African tribes, while Table 5.3 presents such data for western Nigeria. In all of these cases the similarity of proximate motives and circumstances to those found in modern technologically developed nations is fairly striking. Almost all of these

Table 5.1
Apparent Causes of 245 Cases of Suicide in Bastar State, India[a]

Insanity	20
Disease	52
Leprosy	6
Grief on account of bereavement	17
Love affairs	11
Quarrels over property	3
Quarrels between wife and husband	55
Other domestic quarrels	43
Fear of scandal	11
Intoxication	1
Economic: starvation and economic ruin	3
Fear of court and officials	3
Bad treatment by employers	2
Failing in a school examination	1
Not properly reported	17

[a] Source: Elwin, 1943, p. 57. Reprinted by permission of Oxford University Press, Indian branch (New Delhi).

Table 5.2
Apparent Causes of Suicide in Two African Tribes[a]

	Soga suicides		Gisu suicides	
	Men	Women	Men	Women
Physical distress (illness)	28	11	16	8
Mental disorder	6	2	2	5
Quarrels with spouse or lover	12	9	0	3
Quarrels with kin	2	0	0	0
Following own misdeed	5	0	10	3
Unknown and other	11	4	12	9
Grief	3	3	0	0
Old and unwanted	2	2	—	—

[a] Source: Adapted from Bohannan, 1960, pp. 79, 117. Reprinted by permission of Princeton University Press.

Table 5.3
Apparent Causes of Suicide in Western Nigeria[a]

Psychoses	54
Debt	6
Chronic illness	20
No children	2
Low libido (including impotence)	8
Separation quarrel	14
Death of kin	6

[a] Source: Adapted from Asuni, 1962, p. 1095. Reprinted by permission of British Medical Association.

motivations could be construed as fitness problems; the individual is in some severely stressful situation that is found to be unbearable and inescapable. While there are undoubtedly inaccuracies and oversimplifications in tables of this sort, it is difficult to find more detailed case histories of suicide from these cultures that do not implicate some major, protracted, and debilitating stress (see examples in Bohannan, 1960; Elwin, 1943). The stress may be debilitating in a physical sense, as in illness, injury, or old age. Quite often, however, the debilitation is social in nature, in that the individual has lost face or status with tribesmen or kin and consequently may have lost some capacity to promote personal interests through social means.

The causes reported by Meer (1976) for individuals of the different races in Durban, South Africa also support the notion that those committing suicide are among those with impairments to fitness. Meer cites several case

histories from all of the racial groups of individuals suffering from severe depression following some personal loss or some mental disorder. Stress within the family, usually involving conflict between the spouses, is the most common social setting in which suicide occurs in Durban. Not uncommonly, a male suicide is that of a man unemployed or casually employed who contributes irregularly to family upkeep, with suicide following his desertion by wife and children. Many of the suicides among women occur following divorce or separation, while infidelity is also commonly involved. Suicide also occurs among socially isolated individuals, especially among Whites and Africans. Other common causes cited by Meer include physical illness and old age, death of a loved one, financial problems and unemployment, and arrest or capture because of engaging in a shameful act. Individuals falling in all of these categories are unfit relative to other members of the population insofar as the stresses they experience hamper their ability to promote their inclusive fitness.

When suicide occurs in individuals with a relatively reduced personal fitness or capacity to promote their genes, it may have little impact upon the population gene pool. To the extent that suicide does occur in such an ecological position, it may be relatively immune to pressures of natural selection. This is true insofar as the death of the suicidal individual does not extract, from the population, residual reproductive capacity or a capacity to promote inclusive fitness through behavior facilitating the reproduction of relatives.

General Demographic Trends

The notion that suicide occurs largely where it has minimal negative impact on the population gene pool is reinforced by a consideration of the major correlates of suicide in cultures collecting relatively thorough statistics. This includes social-ecological variables such as age, marital or reproductive status, sex, and social contacts.

In Figures 5.1 and 5.2 are given data comparing age, sex, and marital status of suicides in the United States. From these figures it is clear that suicide frequency increases as a linear function of age in men, being much more common among the divorced, widowed, and single than among the married. In women, the increase with age is not so striking, with the highest rates actually occurring in middle age. Divorced, widowed, and single women also show much higher rates than married women. Similar findings, at least with respect to age and sex, are found in other cultures; in Table 5.4 are presented data from Sweden between 1957 and 1959 that show a trend like that found in the United States. Some of the age and sex trends in different cultures were also discussed in Chapter 3.

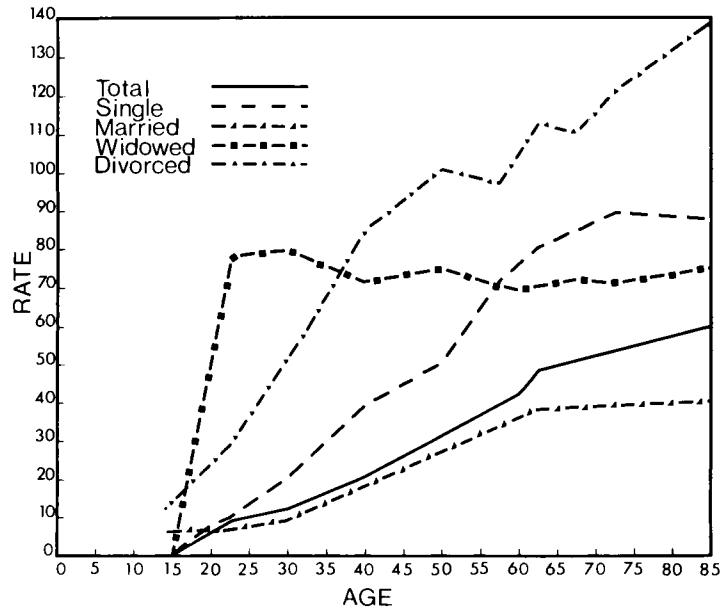

Figure 5.1. *Suicides per 100,000 population per year by age and marital status among white males in the United States, 1949-1951. Source: Linden & Breed, 1976, p. 92. Reproduced by permission of Grune & Stratton.*

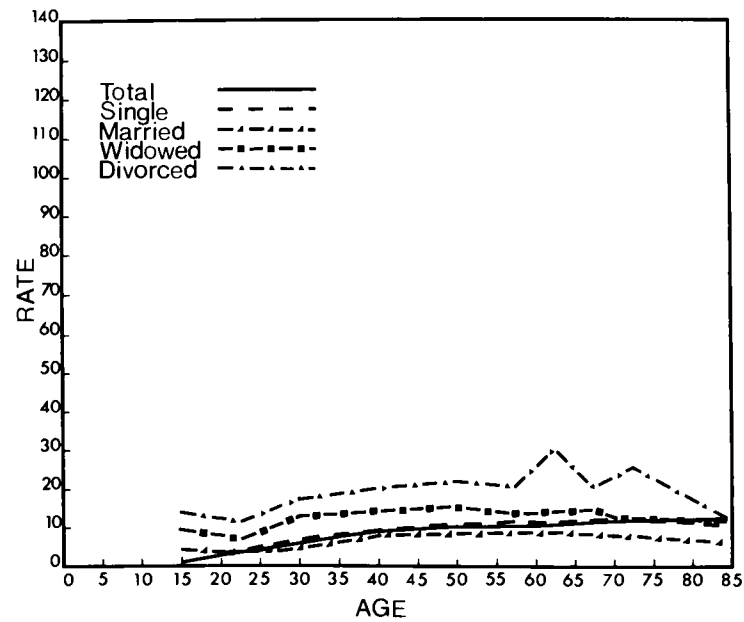

Figure 5.2. *Suicides per 100,000 population per year by age and marital status among white females in the United States, 1949-1951. Source: Linden & Breed, 1976, p. 93. Reproduced by permission of Grune & Stratton.*

Table 5.4
Suicide Rates by Marital Status and Sex in Sweden, 1957-1959[a]

	Males				Females			
	Single	Married	Widowed	Divorced	Single	Married	Widowed	Divorced
All ages (≥ 20)	47.96	31.19	82.46	130.60	16.54	9.50	15.22	28.94
20-39	28.85	16.44	102.79	109.25	13.20	6.37	18.68	31.31
40-59	80.01	37.98	81.81	139.77	22.24	11.56	22.19	35.54
≥ 60	82.00	39.04	82.24	135.87	16.23	11.77	13.27	13.32

[a] Source: Dublin, 1963, p. 28. Reprinted by permission of John Wiley & Sons.

Suicide in Childhood

I would like now to progress through the human life cycle and discuss how age and marital status may affect fitness and the incidence of suicide.

As is evident from Figures 5.1 and 5.2, suicide is exceedingly rare in children under age 14. There may be several biases affecting statistics on childhood suicide. These biases may derive from attempts by parents and others to conceal the true nature of a child's death and the child's use of unique methods that may resemble accidents, such as running in front of automobiles (Shaffer, 1974; Toolan, 1975). Even with these inherent difficulties, estimates consistently indicate that prior to puberty, suicide is rare (Bakwin, 1957; Bender, 1953; Despert, 1952; Shaffer, 1974; Toolan, 1975). In 1954 in the United States, Bakwin found no reports of suicide among children under 10, but that suicides in 10- to 14-year-olds constituted .23% of the total number for that year. Toolan (1962) reports only three cases of suicide in children under age 10 in the United States in 1958. In contrast to low rates in children, there is a dramatic rise in the incidence of suicide at puberty and through adolescence (Diggory, 1976; Shaffer, 1974).

It could be argued that suicide is rare in childhood because children are sheltered by adults from more severe adversities and because differentiation in social, productive, and reproductive status does not occur in earnest until adolescence. A child's reproductive and productive ability is not fully established; thus, in any case child suicide might potentially decrease the frequency of the child's genes, while suicide at older ages may relate to established and diminishing fitness.

Where childhood suicide and attempted suicide do occur, the methods often indicate little premeditation and the behavior often appears impulsive (Gould, 1965; Lucianowitz, 1968; Teicher & Jacobs, 1966; Winn & Halla, 1966). These factors are also believed to decrease the probability that the attempt will be successful; much of the literature deals with attempts rather

than successful suicides and unfortunately does not clearly differentiate between the two. The most common methods are jumping from high places, running into traffic, or hanging (Bakwin, 1957; Gould, 1965; Lucianowitz, 1968; Shaffer, 1974; Teicher & Jacobs, 1966). It is almost universally reported that a disturbed home life is present. Lucianowitz (1968) found evidence of family problems in 100% of suicide attempt cases he examined. Schrut (1964) noted marital disharmony in at least 50% of the suicidal children he studied. Bergstrand and Otto (1962) and Winn and Halla (1966) reported that only a small proportion of the suicidal children they studied came from "normal" homes. Similar conclusions have been reached by several other researchers (e.g., Bender, 1953; Shaffer, 1974). It is frequently proposed that the crucial aspect of the disrupted home life is the associated sense of loss (Ackerly, 1967; Bowlby, 1953; Gould, 1965; Jacobinzer, 1960; Lucianowitz, 1968; Schrut, 1964; Teicher & Jacobs, 1966; Toolan, 1975). Major stresses on the child are usually evident, including frequent changes in home and school, alcoholic parents, incarcerations of the parents for legal or psychiatric reasons, over-expectations, poor peer and sibling relationships, and family financial problems (Ackerly, 1967; Jacobinzer, 1960; Lucianowitz, 1968; Otto, 1972; Schrut, 1964; Teicher & Jacobs, 1966; Toolan, 1975). Suicidal children are frequently described as impulsive or lacking in self-control (Bakwin, 1957; Bergstrand & Otto, 1962; Lucianowitz, 1968; Shaffer, 1974). Suicidal behavior has also been related to mental disturbances such as depression and childhood schizophrenia (Winn & Halla, 1966).

Suicide in Adolescence and Early Adulthood

Suicide in adolescence and early adulthood, because it is much more frequent than child suicide, may present a greater challenge for the notion that suicide occurs where fitness is low. In the United States suicide is the fourth leading cause of death among young people, exceeded only by accidents, malignancy, and homicide (Winickoff & Resnik, 1972). In Japan it is the second major cause of death among males aged 15-29, after accidents, and the primary cause of death for females in that age group (Iga & Tatai, 1975).

Suicide is frequently recorded among students (Knight, 1968; Hendin, 1976; Reese, 1972; Seiden, 1966; Winickoff & Resnik, 1972). In a sample examined by Reese (1972), one-half of the students committing suicide were doing failing or near-failing work at the time of death. Intelligence tests indicated that one-quarter of the students scored below the fifteenth percentile and that many had been exposed to years of academic failure. However, Seiden (1966) reported that university undergraduates in his sample of

suicides showed grades above the mean for their level, although in many cases acquaintances reported that such students showed exaggerated concerns over studies and felt their achievement was insufficient. Graduate students committing suicide from Seiden's sample were below average performance for their level.

Social Isolation

Perhaps the most commonly reported attribute of young people committing suicide is social isolation (Reese, 1972; Seiden, 1966, 1972; Winickoff & Resnik, 1972). Typically, the suicidal young person is asocial and withdrawn. Seiden (1966) described such students as "terribly shy, virtually friendless individuals, alienated from all but the most minimal social interactions [p. 398]." Reese (1972) noted that chronic social isolation was the most striking feature of his group, occurring in students from both large and small institutions. He reported that "case after case revealed students who were, in a literal sense, almost unknown as individual personalities by both faculty and peers [p. 221]." He suggested that the desire to conform and interact was not necessarily lacking in these students, but that they showed long-standing patterns of exclusion from or avoidance of close peer relationship. Jan-Tausch (1963) reported on suicide in New Jersey school children, indicating that in every case the child had no close friends with whom confidences might be shared; indeed, this was the critical difference between successful and unsuccessful suicide attempts. Jan-Tausch furthermore suggested that the suicidal individual has either withdrawn to the point where he or she no longer identifies with any person or idea, or that such an individual sees himself or herself as rejected by everyone. Seiden (1966) noted that, not infrequently, a campus suicide is not discovered for weeks after the death, in that no one is sufficiently involved with the individual to notice that he or she has been missing.

Difficulties in Interpersonal Relationships

Interacting with social isolation may be difficulties in the few personal relationships that do exist, especially with members of the opposite sex. Schrut (1964) argued that isolation has gradually developed over a long time period in adolescent females committing suicide. This has also been associated with progressive family conflict and diminishing interactions with family. Often a fight with or rejection by a boyfriend is a final precipitating factor in the suicide attempt. Jacobs & Teicher (1967) similarly argued that suicidal adolescents usually have numerous and serious problems that progressively isolate them. Frequently they have experienced the instability of a home broken by separation, divorce, or death, and, if living with their family, have

had very poor relationships with them. Luce (1972) noted that in cases where social isolation was not complete, many adolescents had "fallen in love" and formed very possessive and exclusive attachments. Luce argued that this increased the degree of isolation in that they cut off other friendships. If the romance failed, they felt hopeless, lost, and despairing and committed or attempted suicide.

Other Considerations

Other factors that have been related to adolescent and young adult suicide include symptomatic patterns featuring insomnia, anorexia, and extreme moodiness, especially moods of despondency (Seiden, 1966). Drug abuse and mental disorder have also been linked to a minority of cases (Seiden, 1972).

In Japan, high rates of suicide among young people may be related to authoritarianism and pressure to achieve, among other factors. There are tremendous pressures to attend college, with those who fail to gain entrance frequently turning to suicide (DeVos, 1964). Iga and Tatai (1975) point to a strong consciousness of status differences among the Japanese, with an intense desire for success throughout the culture and a strong inclination toward moralistic condemnation of the person who fails in performing role expectations. Iga and Tatai suggest that when individuals fail to satisfy their ambitions and role demands, they may perceive no way out of shame and guilt.

In summary, suicide among young people appears to be precipitated by the stress of failure in ambition and/or sociosexual relationships. Differentiation in social, reproductive, and productive status is rampant in adolescence and early adulthood (see Daly & Wilson, 1978; Symons, 1980), and suicide correspondingly is prevalent. Those committing suicide are generally those with relative difficulties in reproductive and socially productive activities. Social isolation would preclude or make difficult reproductive activity that directly propagates the individual's genes; the individual may simply have difficulty forming sufficiently stable relationships to allow sexual behavior and nurturance of offspring. A socially isolated individual would also be relatively incapable of productive activity that would benefit others sharing his or her genes; this may be particularly true if such an individual is separated from kin, who share his or her genes more closely than do other members of society. Futhermore, success in career is of importance for young people in that it provides the financial and social security that is necessary for promotion of inclusive fitness throughout life. It appears that it is expressly those that are at relative disadvantages in reproductive and productive endeavors who commit suicide in adolescence and early adulthood.

Qualifications

Nonetheless, some proportion of suicides among young people might present a major problem for the notion that suicide occurs where there is little residual capacity for individuals to promote their inclusive fitness. This problem would occur to the extent that potential reproductive and productive capacity is lost due to some youthful suicides. Haim (1970) argues that the circumstantial factors surrounding adolescent suicide often do not appear sufficient to motivate the act. He notes that there may sometimes be an excessive influence of contagion or modeling (see Chapter 6) from the example of other suicides, from friends, or from persons mentioned in the communications media. However, the stresses or coping difficulties experienced by young people may stem more from longstanding conditions than from proximate circumstances, as Haim (1970) suggests. Clearly, additional research is needed to clarify the relationship of coping difficulties and suicide among young people. Much of the research, as reviewed above, suggests that difficulties in achieving biological fitness are very commonly antecedents of youthful suicides. The severity of these coping difficulties may not always be such that effective promotion of inclusive fitness is precluded, and hence some proportion of youthful suicides may be truly maladaptive in a biological sense. The phenomenon of suicide seems to occur not only in individuals who have experienced some absolute and permanent coping failure, but also in some cases where there is coping failure only *relative* to the coping ability of peers.

Age and Reproductive Status in Adult Suicide

It should be clear that reproductive status is one critical factor in the etiology of suicide in adolescents and young adults. Individuals committing suicide are most commonly those without relationships to members of the opposite sex, with recent failures in such relationships, and/or with poor prospects for the financial and social security necessary for fostering young or otherwise promoting inclusive fitness. The situation among older adults further illustrates the notion that reproductive status is a critical determinant of suicidal behavior.

Sex Differences

Aging has a variety of consequences for fitness that are sex-dependent. The strategy for gene propagation assumed by human males may differ substantially from that assumed by females (Daly & Wilson, 1978; Symons, 1980), and aging accordingly has different effects on fitness. Males in many

human cultures, as well as in other species, are in a higher-risk situation, with the potential for either great reproductive success with more than one female, some intermediate state such as monogamy, or total exclusion from reproductive activity. Success in reproductive endeavors for males may be quite contingent upon success in social status, economic or productive endeavors, and other forms of intermale competition. Females, however, can produce only a limited number of offspring. A common female strategy in human cultures has involved affiliation with one male in a monogamous relationship that symbiotically, through role specialization, facilitates reproduction. Such a monogamous relationship may also hold benefits for many males, but is not the universal nor necessarily the most advantageous strategy for males (Symons, 1980). A particularly successful male may be able to propagate with several females, hence increasing his inclusive fitness markedly. Some males, however, may be excluded entirely from reproduction because of competition from more successful males. Females may less often be in a situation where they are totally excluded from reproduction.

Males are currently subject to higher mortality than females from a wide variety of causes, including various diseases and accidents as well as suicide (Retherford, 1975). This pattern may have differed considerably across cultures and over human history (see Acsádi & Nemeskéri, 1970), and may have particularly been altered through changes in general mortality in modern, technologically developed societies (Retherford, 1975). Cultural factors modulate the relative viability of human males and females.

The sex-age patterns in suicide appear to reflect differences in risk of exclusion from direct reproductive opportunities. As age advances, reproductive prospects for men may generally decline. Men in modern contexts are more likely to be sexually active with fertile females in earlier life, although there are exceptions. Although the capacity for sexual activity and the fertility of the ejaculate may remain in men in old age, opportunities for reproductive arrangements with women in optimal childbearing ages probably decrease with increasing age. Furthermore, senescence may bring a reduction in the capacity to nurture offspring and engage in other productive behavior that promotes the individual's genes as they exist in younger, reproducing, related individuals. Hence in men, the cost of death through suicide in terms of lost reproductive capacity generally diminishes with increasing age. Although many men may remain reproductively active and productive in later life, it is probably these men that are least inclined toward suicide, as will be demonstrated in the discussion below on reproductive status. Men with declining reproductive potential and/or who are experiencing other major, debilitating stresses are those most likely to commit suicide; with increasing age more men may fall in such categories, accounting for the increase in suicide frequency as a function of age.

In women, the situation is more complex. Females currently have a longer average life span than males, reaching senescence at a later age. However, the probabilities of successful reproduction diminish substantially with increasing maternal age, and it is well known that the incidence of unsuccessful pregnancy and birth defects increases as menopause approaches. Menopause in women involves a complete cessation of direct reproductive potential, unlike the situation in men. Nonetheless, women may traditionally have more frequently engaged in direct nurturance activities that promote their genes as they exist in children and other relatives (Daly & Wilson, 1978; Symons, 1980). Thus, after the loss of childbearing capacity, women may have held substantial ability to promote their inclusive fitness through nurturance of children, grandchildren, and other relatives sharing their genes. Because of these nurturance activities, a woman's suicide may on the average have been more costly in terms of lost reproductive potential than would be a man's, particularly in older ages. As long as some capacity to aid in the nurturance of related individuals such as children or grandchildren remains, the suicide of a postmenopausal woman is costly in terms of her fitness. Other possible reasons for a sex difference in suicide rates will be discussed in Chapter 8.

Marital Status and Children

Rates of suicide tend to be low among those with stable marriages but quite high among the widowed, divorced, single, and those with unstable marriages (Diggory, 1976; Dublin, 1963; Durkheim, 1951; Linden & Breed, 1976; McCulloch & Philip, 1972). Frequently the death of a spouse, divorce, or difficulties with members of the opposite sex are proximate antecedents of the act of suicide (McCulloch & Philip, 1972). Furthermore, rate of suicide may be especially low among those with children (Breed, 1966; Dublin & Bunzell, 1933; Kozak & Gibbs, 1979). Presumably, those with stable marriages are those most capable of carrying their genes into future generations, while those with children are especially capable of behaving toward the benefit of individuals sharing their genes, as each child theoretically carries about one-half of each of his or her parents' genes (see Hamilton, 1964; Trivers, 1972).

As early as the nineteenth century, researchers found that marriage and the family provided some immunity against suicide (Bertillon, 1951; Durkheim, 1951; Morselli, 1822). Durkheim (1951), in his pioneering work in the latter part of that century, postulated that suicide varies inversely with the degree of integration of domestic society. Durkheim suggested that married persons after age 20 have some immunity against suicide, that parenthood increases this immunity, that widowhood and divorce aggravate the tendency toward suicide, and that the preservation against suicide provided

by marriage is greater for men than for women. He observed that childlessness increased the probability of suicide among married women, and that greater immunity to suicide came with greater numbers of children. He found that the suicide rate declined in widowhood when there were children. These postulates have generally been confirmed in modern studies of suicide (e.g., Breed, 1966; Diggory, 1976; Dublin, 1963; Dublin & Bunzell, 1933; Gibbs, 1957; Kozak & Gibbs, 1979; Linden & Breed, 1976; McCulloch & Philip, 1972; Meer, 1976).

Clearly, these data provided by Durkheim and others support the notion that suicide usually occurs where reproductive potential is diminished, and that it is relatively unlikely where there is a strong capacity to promote inclusive fitness. Individuals capable of promoting their genes through sexual and nurturance behavior are those least likely to commit suicide. Suicide occurs largely where it removes little capacity to propagate genes, or where it has the least impact on the gene pool. Despite the early identification of these trends in social ecology and the now abundant data supporting them, there has been little recognition of their biological significance. An evolutionary perspective indicates a remarkably consistent pattern.

Meer (1976) summarizes Durkheim's postulates on marital status and family thus:

1. Widowed persons commit suicide more than married persons but generally less than unmarried persons.
2. Men find widowhood and divorce more distressing than women.
3. Divorce is the most distressing of all marital conditions.
4. Widowed and divorced persons with children commit suicide less than those without children.

Meer concludes that subsequent studies testing these propositions have confirmed all but the second half of the first postulate. The finding that having children protects against suicide is particularly concordant with the notion that suicide is unlikely where a capacity to promote one's inclusive fitness remains. Divorce and widowhood may facilitate suicide to the extent that opportunities for reproduction and nurturance of young are lost; if the individual is relatively incapable of establishing new relationships with members of the opposite sex or has no children, the loss of fitness may be especially acute. Divorce may be quite stressful to men if subsequent custody of children is generally granted to women.

Other Cultures

The longstanding custom of suttee in India readily fits this framework. This may be especially true given the sanctity of marriage and the fact that remarriage has not been customary in that part of the world (Venkoba Rao, 1975).

Venkoba Rao points out that other causes related to reproductive difficulties such as impotence, other sexual problems, and sterility or childlessness, are common causes of suicide in India.

The literature is replete with case histories where some direct impediment to reproductive success is a prominent proximate determinant of suicide. This is true for almost any of the cultures in which suicide has been studied. For example, if we examine information on the circumstances of suicides among the Soga provided by Fallers and Fallers in Bohannan's (1960) book, a role of reproductive and marital status is quite clear. Of 100 cases, impotence is cited in 8 cases and venereal disease in 4 cases. In at least 30 cases, death or desertion of spouse or a major quarrel with spouse is cited as a primary circumstance, while severe disease such as leprosy, epilepsy, insanity, or protracted hernia is cited in at least 32 other cases. In remaining cases death of other relatives or major conflict with them, shame over some transgression of law or custom, or unknown causes are involved. It is difficult to find a single case cited in Bohannan's (1960) book where biological fitness does not appear to have been impaired in some specified manner.

Table 5.1 indicates that among the cases of suicide documented by Elwin (1943), loss of or difficulty with spouse or lover was involved in a sizable minority of cases.

In Table 5.5 are given data from the various racial groups in South Africa. These data clearly suggest that, with the possible exception of the African population prior to 1960, suicide in all racial groups is much higher in the single, widowed, and divorced than in married individuals. Meer (1976) has

Table 5.5
Suicide Rate per 100,000 by Marital Status, Race, and Sex in Durban, South Africa[a]

	African		White		Coloured		Indian	
	Men	Women	Men	Women	Men	Women	Men	Women
	1940-1960							
Married	3.6	7.9	17.6	5.3	6.7	11.2	20.2	17.7
Never married	3.0	4.8	22.3	4.3	14.8	8.3	47.4	36.3
Widowed	4.3	2.7	55.1	5.8	—	15.0	74.5	13.2
Divorced	—	—	48.0	3.3	—	70.5	57.7	—
	1962-1970							
Married	8.5	7.4	27.8	10.4	38.0	18.7	31.7	16.5
Never married	60.1	12.7	48.9	14.8	51.9	11.4	41.1	22.5

[a] Source: Meer, 1976, p. 259. Reprinted by permission of Routledge & Kegan Paul Ltd.

provided a valuable review and discussion of the notions that marriage and the family restrain suicide. With some exceptions, the trends outlined for North American and European cultures also hold in Durban. These exceptions are complex and dependent on the race under consideration, and may relate to sample size differences or differences in social and family structure and custom (see Meer, 1976, pp. 81-95).

A relatively clear example of how differences in marriage, family, and social customs may alter the trends in suicide is provided by Asuni's (1962) data from western Nigeria. Marital status cannot be defined for this area within the same framework as in monogamous societies. Marriage by traditional custom is just as easily broken as it is contracted, and consequently very few remain separated or divorced for long. In any case, in a polygamous setting a man may still have other wives when he is separated or divorced, although a separated or divorced woman may remain unattached. This may be one reason why suicide rates are so low in western Nigeria, in that individuals may be less likely to arrive at a position in which their potential for reproductive behavior, and thus gene propagation, is very low. The age trends in this area are also of interest. As elsewhere, there is no record of suicide below age 15. However, there is apparently no difference in suicide frequency between the age category 15-49 and the category 50 and over. Asuni argues that this difference cannot be attributed to a shorter life expectancy. Rather, it may be due to the fact that in Nigeria old age still commands great respect, while the extended family grouping provides emotional and physical support for the old. This, taken with the low rate of suicide in this area, may underscore the importance of mutually supportive contact with kin as a deterrent of suicide.

Trends that differ from the prevailing age-sex distribution of suicides in Western cultures have been noted for some Oriental cultures (Iga & Tatai, 1975; Murphy, 1954; Yap, 1958). A lower incidence of suicide among the aged in Oriental cultures has been attributed to the traditional veneration with which old age has been treated in such cultures (Yap, 1958). High incidence among youth, and a higher proportion of suicides among young females, have been related to a variety of stresses experienced by young adult members of both sexes in such cultures (Iga & Tatai, 1975; Yap, 1958). Such cultural differences in the social ecology of suicide do not challenge the notion that suicide occurs where the capacity to promote inclusive fitness is low insofar as the act is precipitated by culture-specific stresses. Murphy (1954), for example, points to chronic debilitating disease, burdensomeness, serious financial trouble, and failure to achieve as common antecedents of suicide in Singapore. Severe coping difficulty appears to correlate strongly with suicide in virtually all cultures.

Other Trends in Adult Suicide

Social Isolation

Above it was stated that suicide among young people is commonly related to social isolation. This trend can also be taken as another common denominator in adult suicide, in that a substantial proportion of adults committing suicide have few strong relationships to others in society (Breed, 1972; Ganzler, 1967; Stengel, 1973; Worden, 1976). Indeed, social isolation or loneliness is the principal cause cited in the first documented case of suicide in human history, which occurred in Egypt (Choron, 1972). Durkheim (1951) posited that one major class of individuals committing suicide, which he called "egoistic" suicide, occurred when an individual had insufficient ties to society. Henry and Short (1954) similarly argued that the suicide rate in a population varies inversely with the strength of the relational systems of its members. Sainsbury (1955) identified social isolation as a major etiological factor in his study of suicide in London. Social isolation may decrease reproductive fitness in that it entails insufficient access to members of the opposite sex. Socially isolated individuals would also be relatively incapable of engaging in productive activity benefiting others sharing their genes; this is particularly true when there is separation from kin.

That the effect of social isolation is also culture-bound is evident from Asuni's (1962) study of western Nigeria. Individuals living alone in that area actually show lower rates than those not living alone. Asuni argues that living alone in Nigeria does not necessarily imply the same degree and quality of isolation as living alone in temperate countries. The design of houses, the climate, and the pattern of life do not favor social isolation. There are no boarding houses, and living is an outdoor rather than an indoor affair, with doors and windows to houses kept wide open. Asuni furthermore suggests that because of local hospitality and generosity, a stranger is fairly readily accepted and absorbed into a new community. This suggests yet another reason why suicide rates are very low in this region.

War and Depression

Another trend that is often cited is that suicide varies with the economic welfare and involvement in war of a society, with high rates during economic depression and low rates during war (Dublin, 1963). The high rates during depression are clearly consistent with the arguments of this chapter in that many individuals' fitness would be severely and chronically reduced by economic difficulties. Suicide in time of war may be influenced by several factors; for example, potentially suicidal young men may die as soldiers; these and others may find new purpose and integration into society with the causes

of their side in the conflict; while despair may be unjustified with the potential for major and possibly beneficial social upheaval.

Race Differences

One problem for the notion that suicide occurs where stresses and personal fitness problems are greatest is the fact that suicide rates may be relatively low among black populations in the United States (Swanson & Breed, 1976) and South Africa (Meer, 1976), since these black populations may be among the most disadvantaged. However, one consideration is that homicide rates are relatively high among blacks in the United States and may interact with the suicide rates (see Henry & Short, 1954; Swanson & Breed, 1976). Other possible causes of racial differences in suicide frequency will be discussed in Chapter 8.

Suicide among the Gifted

Another potential problem for this analysis is the occurrence of suicide among individuals considered to be "gifted." However, from Shneidman's (1976b) review it is apparent that major and potentially debilitating life stresses are often involved in such cases. Such stresses may include some "recent downhill course," chronic social and personal instability, disease, or marital difficulties. Other examples of suicides of gifted individuals are those among students at prestigious British universities such as Oxford or Cambridge, where the suicide rate substantially exceeds that at other British universities (Seiden, 1972). Discrepancies between expectations and performance are likely involved in many of these cases; Seiden's (1966, 1972) reviews of campus suicide clearly suggest that personal stresses and social isolation are major determinants. We must consider that high intelligence, although undoubtedly an asset, is not a sufficient condition for successful adaptation. Also, creative or productive individuals may lose their capacity to create or produce, or encounter other stresses that permanently threaten their fitness.

Exceptional Cases

A minority of cases may not entirely fit the generalization that suicide occurs where the capacity to promote inclusive fitness is low. In some cases, especially where it occurs among young people, suicide may stem from difficulties in coping that are potentially transitory. In some other cases, a coping difficulty may occur only relative to the individual's unrealistic expectations of his or her achievement. I will discuss potential reasons for these and

other exceptional cases in Chapters 7 and 12. Perhaps the foremost reason why suicide sometimes occurs in those with a residual capacity to promote their inclusive fitness is that individuals believe that their coping difficulties are greater than they are in fact. Also, the modern situation is such that suicide occurs in culturally, socially, and technologically novel situations. Because there is a lag between cultural change and biological adaptation, pathological or biologically maladaptive behavioral conditions may be unusually frequent in modern cultures (see Chapter 7).

Also, the generalization that suicide occurs where fitness is low may overpredict the incidence of suicide, in that by no means all individuals that cannot effectively advance their fitness will commit suicide. The generalization does not hold in this predictive sense. The assertion that suicide tends to occur where the capacity to promote inclusive fitness is low is only meant in a relative or probabilistic sense. It does not mean that the capacity to promote fitness is entirely lost in most cases of suicide, nor does it suggest that exceptional cases cannot occur. Rather, suicide *generally* tends to occur among those in the population with relatively reduced fitness.

Summary and Interpretation

A conjoint consideration of evolutionary pressures and the social ecology of suicide makes it abundantly clear that suicide usually occurs where it might have little impact on the gene pool. This is at least true in a relative sense, in that those committing suicide are among those with relative impairments in their ability to promote the continued existence of their genes in the population. When individuals with such impairments die, their death effectively does not extract genes from the gene pool. Such individuals have already suffered "genetic death." However, when an individual with reproductive and/or some productive (in the sense that it promotes related individuals' welfare) ability dies, the frequency of genes in the gene pool is affected. Thus, a strong selective pressure acts against the occurrence of suicide in individuals with a residual capacity to cope, but relatively few selective pressures may act against the suicide of individuals that can neither cope nor recover the ability to cope.

Thus, in a sense, suicide occurs where it anticipates a minimal biological consequence. There is a striking correspondence between the actual social-ecological location of suicide and the location in which it would have the least apparent evolutionary consequence. This provides the first major pillar in the sociobiological analysis of self-destructiveness, in that it begins to resolve the biological anomaly that this behavior presented in the logic of

Chapter 1. But it raises as important a question as the one it answers. In any particular case of suicide, the subsequent effect or lack of effect on the gene pool cannot influence the suicidal behavior because the behavior antecedes this effect. The behavior is apparently much less maladaptive than it might appear, and the challenge becomes one of explaining why it occurs where it does. Some positive reason or set of reasons is still required to explain its occurrence.

6

Cultural Evolution and Suicide

Suicide is not entirely maladaptive, given the tenets developed in Chapter 5. It may not always reduce or delete much biological fitness, insofar as it generally occurs where fitness is already low. It deletes individuals, but in many of its instances it may not greatly affect the genetic content of the population, at least not to the extent suggested in Chapter 1. Accordingly, suicide is relatively immune to natural selection. We have now to explain why it occurs in this ecological situation and to provide some positive reason why it should occur at all. I would like over the next several chapters to develop the notion that suicide derives from a synergy of cultural and biological pressures. In this chapter the roles of learning, cognition, technology, and culture are examined.

The discussion in Chapter 4 of the cross-species incidence of self-destructiveness strongly suggested that suicide is a human phenomenon. There are some possible exceptions and pseudosuicidal behavioral patterns in nonhumans, and it may be premature to dismiss suicidal behavior in other species entirely. However, true suicide, where the organism directly removes its life with no readily apparent benefit for its fitness, is at least much more common in humans than in other species. This leads us to ask whether any unique features of human behavior and ecology might account for it. Human behavior can generally be distinguished from that of other animals in a number of relevant respects, notably communicative ability, complexity of the social structure, and flexibility of the behavioral repetoire (Washburn, 1978; E. O. Wilson, 1975). These differences have allowed the development of cultural evolution, which permits changes in behavior, social patterns, and technology without the direct influence of biological evolution (see Alexander, 1979; Dobzhansky, 1961; Durham, 1979; Irons, 1979). Human

behavior is determined by learning to an extent that is not paralleled in other species. Learning permits changes in behavioral phenotypes within each individual's lifetime, and thus engenders fine adjustment of behavior to the environment. Many behavioral patterns are neither directly controlled by genetics nor directly subject to natural selection.

Accordingly, we must ask whether suicide is or is not entirely learned behavior. Skinner (1969) argued briefly that suicide must result from learning. He reasoned that any genetic mutation favoring suicide would quickly eliminate itself, and that therefore suicide must result from learning experience rather than inherited predispositions. Skinner's argument is weakened because he did not consider the social ecology of suicide and the consequent complexity of selective pressures that might affect it; counters to his argument will be developed in subsequent chapters. However, it is quite plausible that learning is of principal importance in the etiology of suicide. Human behavioral flexibility may be such that the occasional behavior acting against survival and normal biological trends might arise. Our learning capacity may be so great that we are capable of learning self-destructiveness. Thus, suicide may occur as the occasional by-product of an otherwise generally highly adaptive behavioral flexibility.

Technology and the Origin of Suicide

At the very least, many of the methods employed to commit suicide must be learned. Some of the most common methods employed today in developed nations, such as gunshot, drug overdose, gassing, and automobile collision (see McCulloch & Philip, 1972; Stengel, 1973) employ modern human technological innovations. These methods and their effects would have to be learned; they have not been available for a sufficient number of generations for biological predispositions toward their use to be developed. These methods could only be transmitted through learning and cultural evolution.

On a worldwide basis, perhaps the most common method of suicide is hanging (*World Health Statistics Report*, 1968). It is probably the most common method in lesser developed societies, being by far the most prominent method in all African societies examined by Bohannan (1960) and his collaborators, and among the primitive peoples of central India examined by Elwin (1943). Hanging was also one of the more frequent methods among Amerindians studied in the nineteenth and early twentieth centuries (Devereux, 1961; Weyer, 1932) and in the sixteenth century in South America (de Cieza de León, 1959). It was also not uncommon in Greek, Roman, and biblical times (Dublin, 1963; Rosen, 1971; Westermarck,

1908). It remains a common method in developed nations today, being the second or third most frequent method in Great Britain and the United States (see Table 2.2 on p. 16). Hanging usually involves the employment of a technology, albeit one which has been available as long as man has worn clothing and employed ropes or vines as tools. Elwin (1943) describes self-hanging among aboriginal peoples in India as follows:

> The method of self-execution seems to be to climb up the tree, to attach and arrange the cord and then jump down. When the suicide occurs inside a house, the person stands on a fish-trap or basket and kicks it away. In many cases the rope consists of the victim's own loin-cloth, turban, or sari, but several different kinds of rope are also used. Rope made from the twisted siari . . . creeper is perhaps the most common. Jute cords for tethering cattle, and ropes made of various kinds of bark are also used [p. 48].

Other simple technologies used in suicide must have long been available to human beings. These include fire, a common tool in suicide among African and Asian women in South Africa (Meer, 1976; see also Table 3.7 on p. 37); cutting and piercing instruments, which, for example, were commonly employed in Greek and Roman times (see Farberow, 1972; Rosen, 1971); and poisons derived from plants, also employed in classical times (Rosen, 1971) and by some primitive tribes such as the Trobriand Islanders (Malinowski, 1926) and early Amerindians (Devereux, 1961). Such methods involve tools that were probably acquired early in human cultural development.

Other methods, such as self-drowning, jumping from high places, and exposure of self to harsh elements must have always been available both to man and other animal species. Self-drowning and exposure to the elements were commonly employed by Eskimos (Leighton & Hughes, 1955; Weyer, 1932). Drowning may have, until recently, been the most common method in India as a whole, being equal to hanging in frequency among men and occurring in six out of seven female suicides (Ranchhodas & Thakore, 1911, cited in Elwin, 1943). Drowning by swimming out to sea, where an individual might be overcome by heavy seas or by sharks that are common off the coast, is a very frequent method in the community of Tikopia in Polynesia, especially among unmarried young women (Firth, 1961). One of the methods occurring among the Trobriand Islanders is reported to involve jumping from a tree top (Malinowski, 1926).

One critical reason why suicide is not found in other species may be that it is inextricably linked with a capacity to employ tools. Indeed, we might surmise that suicide began to occur in early human culture as tool use and cultural transmission of such tool use developed. Certainly the occurrence of suicide is facilitated by the availability of several technologies for readily effect-

ing death. We might note again the fragmentary indications that suicide is unknown among the least technologically advanced of human cultures, such as Australian aborigines (Steinmetz, 1894; Westermarck, 1908), although the quality of data for such cultures is poor.

Thus, given the absence of suicide in nonhuman animals and the human cross-cultural incidence and methodology of suicide, we are led toward the conclusion that suicide may in past have arisen as the human behavioral repetoire was expanded by growing technology. In order to commit suicide an individual would have to acquire knowlege about the use of such tools through his or her culture. However, the occurrence of suicide in some cultures through relatively nontechnological means does present some difficulty for this notion. As will be discussed below, other aspects of human behavioral flexibility may have been involved. The question of pretechnological suicide, like that of animal suicide, should not be closed prematurely.

Transitions in Methods and Technology

There have been some rapid transitions in methodologies of suicide in various cultures as their technologies advance. A good example comes from Japan (see Iga & Tatai, 1975). The dominant method of Japanese suicides up until the 1950s was hanging; after that pills and poisons became the primary method. In England and Wales, hanging similarly was the most common method in the late nineteenth century but is now surpassed by gassing and poisons, whereas drowning was also formerly much more common than it is currently (cf. Littlejohn, 1910-1911; Stengel, 1973). One question this raises is whether the suicide rate has also risen during this period, with the increase in rate corresponding to the increased use of new technologies. The example of England and Wales suggests that this is not the case; suicide rates are currently very similar to those occurring in the late nineteenth century (see Littlejohn, 1910-1911). Indeed, the frequency of suicide through hanging and drowning has declined, being supplanted by suicide through drugs and gassing (cf. Littlejohn, 1910-1911; Stengel, 1973). Furthermore, the not infrequent occurrence of suicide in earlier periods of human history and in primitive tribes suggests that there has been no massive increase in suicide with the technological advances of modern society, although the data are inadequate to support any precise comparisons over history.

This suggests that suicide is not a simple function of the availability of technologies. The method may be quite independent of the motive. A hypothetical individual under duress may formerly have chosen to hang himself or herself, while the counterpart of such a person under similar duress today may take a barbituate overdose. The availability of means is not

a sufficient condition for the occurrence of suicide. Rather, motivation to seek death is probably determined by several other factors, as discussed in the next several chapters, whereas the method employed may be directly influenced by availability and culture. We cannot account for the social ecology of suicide simply on the basis of availability of methods. Most individuals do not commit suicide despite daily exposure to several means of doing so. However, those subjected to protracted and inescapable stress often do commit suicide and apparently seek out whatever methods are available.

Nonetheless, it is very plausible that the earliest suicides were facilitated by increasing availability of means, and that the notion and practice of suicide subsequently diffused through human culture. Similarly, the occurrence of suicide in modern cultures may be facilitated, although not caused, by the ready availability of several means for effecting it.

Cognition and Suicide

Related to the flexibility of the human behavioral repetoire is an apparently unparalleled cognitive capacity (see, for example, Bransford, 1979; Crook, 1980; Kintsch, 1977; Wickelgren, 1979). Neurological activity occurs in the absence of direct sensory stimulation; a considerable amount of cognition or information processing may mediate stimulus-response relationships. It is conceivable that such cognitive capacity, although generally highly adaptive, brings with it some independence of behavior from biological constraints. Also, or alternatively, this cognitive capacity may in a complex manner facilitate the alignment of behavior with biological constraints, causing suicide to occur where its impact on the gene pool is limited.

Behavioral Flexibility and Maladaptive Suicide

Human thought and logic allow a fine adaptation of behavior to environmental contingencies, whereas a genetically preprogrammed behavioral repertoire would be much more rigid. This flexibility may allow behavior to occur outside the normal bounds that limit animal behavior to patterns promoting the individual's existence. Even if, contrary to the discussion of Chapter 5, suicide is maladaptive and acts against fitness, behavioral flexibility may normally be so adaptive that the occasional maladaptive by-product such as suicide may be tolerated in natural selection. The maladaptive by-product may be a necessary adjunct of this flexibility, with the net effect of the flexibility nonetheless being highly adaptive. This argument would suggest that evolutionary pressures may not influence the finer aspects of human behavior; rather, it suggests that they determine only the major dimensions of behavior.

On the basis of the discussion of Chapter 5, the notion that suicide is an evolutionary error occurring as a by-product of some adaptive process is somewhat tenuous. Suicide does not appear, in the main, to be maladaptive in a true biological sense, in that it does not subtract a significant amount of reproductive potential from the population. This suggests that behavior is actually fairly finely aligned to biological contingencies despite the human behavioral flexibility. The major challenge to a purely cognitive or learning approach to suicide is to explain why suicide anticipates a minimal biological consequence, or why it occurs principally in members of the population that are relatively unfit.

Behavioral Flexibility and the Social Ecology of Suicide

An alternative notion is that cognition is implicated in the determination of suicide, but that it interacts with biological factors in complex manners to account for the social ecology of suicide. A general motivational substrate may be inherited by each individual, orienting his or her behavior toward inclusive fitness (see Chapters 1 and 10). Overlaid on this substrate are cognitive and learning abilities, which *within the bounds of the substrate* would allow a substantial amount of behavioral flexibility. Every individual may be born with general predispositions orienting behavior toward inclusive fitness. These may shape learning such that the individual acquires behavioral patterns promoting fitness, and may shape cognition such that the individual's conscious interests roughly correspond to his or her biological interests. Individuals may also have some conception of their status in achieving the ends they are biologically predisposed toward seeking. If they are failing to achieve these ends and perceive poor prospects for future improvement, they might conclude that there is little purpose to their lives. Such an individual thus might infer a futility to existence, and no reason not to seek death. Such logic would not by itself provide a positive reason for suicide, but rather might remove the disincentive. A positive reason for suicide might derive from more complex logical processes acting in synergy with biological contingencies, as will be discussed in subsequent chapters.

Other Theories of Cognition and Suicide

There is much discussion in the literature of evidenced and inferred cognitive conditions of individuals committing suicide, and there is general agreement that suicide is usually a premeditated act (e.g., Levenson, 1974; Neuringer, 1976; Shneidman, 1957, 1961, 1976c; Tripodes, 1976; Wetzel, 1980). The best cognitive data are derived from suicide notes and clinical information collected prior to the act; other information may come from ac-

counts of the individual's verbal behavior by others interacting with him or her. Suicide notes have the value of being the last written communication by the individual and as such probably reflect the person's cognitive state at the time of the act. Most often, however, there is no suicide note and little other data on the individual's cognitive condition.

Shneidman (1957, 1961) argued that the suicidal decision is reached by reasoning based on essentially fallacious logic. He concluded that the suicidal person commits a certain type of logical error, which he labeled "catalogical." This logic is characterized by semantic errors, in which the error is dependent on the meaning of terms in the premises or conclusions of a syllogism, but not by deductive fallacies. For example: "If people kill themselves then they will get attention; I will kill myself: therefore I will get attention [Shneidman, 1957]." The fallacy, of course, exists in the word *I*, in that the individual will not survive to experience the benefit of the attention. Individuals may see their successful suicide as producing some desired effect on the environment, but not live to experience the intended improvement in personal fitness.

A similar problem may occur if individuals commit suicide intending to remove themselves from pain or other aversive events. Normal, non-life-threatening behavior that removed aversive stimulation might improve fitness, whereas suicide may be unlikely to do so. Other cognitive aberrations conducive to suicide may occur where an individual believes that death will bring an afterlife that is better than present life or that he or she will rejoin a lost relative or companion. Such logic suggests that the individual falsely believes that the suicidal behavior increases fitness. It is unclear, however, whether such logic characterizes more than a minority of suicides, since the available data are quite incomplete. Furthermore, it is unclear whether the logic is a principal determinant of the suicide or is simply a concomitant of some more general set of determinants. Faulty logic alone might not account for the social ecology of suicide; protracted and inescapable stress would seem to be a much more consistently present proximate determinant. The attribution of suicide to aberrant logic fits the notion, discussed above, that suicide is a negative by-product of behavioral and cognitive flexibility, and carries with it the difficulties of that notion.

Neuringer (1976), elaborating on Shneidman's (1957, 1961) notions, has argued that suicidal individuals have a tendency to think dichotomously, or to polarize concepts in an extreme and rigid manner. The individual uses terms such as *all*, *none*, *always*, and *never*. Neuringer argues that the lack of intermediacy leads the individual into corners from which escape is difficult. The real world is not congruent with the psychological world of extreme dichotomous expectancies; failure to realize extremes "makes life miserable for the suicidal individual [p. 238]." The difficulty with Neuringer's contentions for our purposes is that cause and effect are quite unclear. While

suicidal individuals may or may not display such thinking, the thinking may be more a result of the stresses experienced by the individual than a proximate determinant of suicide. Furthermore, we are still left with the need to explain why those who are miserable because of their rigid thinking turn to suicide. Also, Wetzel (1975a,b,c) showed that the tendency to think dichotomously applied only to concepts relevant to the suicidal crisis, such as *life* and *self*. Wetzel also found that evaluation of life and self changed over time in manners correlated with suicidal intent, depression, and hopelessness.

The most useful cognitive analyses of suicide for our purposes may be those of Beck and his associates (Beck *et al.*, 1975; Minkoff, Bergman, Beck, & Beck, 1973). As previously mentioned, Beck has linked suicide to hopelessness, operationally defined as a negative view of the future. Wetzel (1976a, 1980) has replicated Beck's data, providing further support for the idea that suicidal intent arises when an individual has a negative view of self and future self. Others (e.g., Kaplan & Pokorny, 1976) have confirmed that negative self-images characterize the thinking of suicidal individuals. The importance of this cognitive dimension was discussed in the last chapter and will be raised again in later chapters. A cognitive state of hopelessness implies that individuals either recognize an existing state in which the capacity to promote their interests has been lost or that they falsely perceive such a state. We might presume, to the extent that human cognition parallels reality, and because objectively definable stresses are usually identifiable in the lives of the suicidal, that such a cognition is more often accurate than not. According to our assumptions about what biologically constitutes an individual's interests, it seems most likely that a cognitive state of hopelessness arises where an individual truly has reduced capacity to promote inclusive fitness.

The Death Concept

The individual's concept of death may also be of critical importance. One of the reasons commonly cited for the infrequency of child suicide is that the death concept is inadequately developed before adolescence (e.g., Seiden, 1972; Winn & Halla, 1966). Nagy (1959) studied the developmental sequence of children's death concepts, positing that a child does not realize that death is a final cessation of bodily functions until age 9 years or older. Rochlin (cited in Seiden, 1972), however, has indicated that children are quite concerned with death and aware of their own mortality by age 3 or 4, although they may view death as temporary or reversible. If a child has an undeveloped concept of death, he or she may not be able to conceive of the act of suicide. Seiden (1972) has argued that it is doubtful whether the few cases of suicide in children under age 9 involve an intention to die, because of an incompletely developed death concept.

Although the concept of death may be involved at some level, it alone

cannot account for the occurrence or nonoccurrence of child or adult suicides. Since by no means all individuals with a developed death concept commit suicide, some positive reason for suicide may be more important than the status of this concept. The possibility, discussed in Chapter 5, that low suicide rates in children relate to a lack of differentiation in reproductive and productive potential, may provide a better explanation for the relationship of age to suicide frequency. We have to account for the manner in which the concept of death interacts with various motivations for the act.

An argument similar to that made for child suicide could be applied to the relative absence of suicidal acts in other animal species. Insofar as nonhumans may be less knowledgeable of the nature of death, they may be less capable of conceiving of self-induced death. One problem with this notion is that nonhuman animals are quite capable of many other goal-oriented forms of behavior without displaying evidence of elaborate cognitions concerning the goal. Nonetheless, a knowledge of death may have facilitated the initial occurrences of suicide in human cultural development and may be involved in the etiology of modern cases. The fact that suicide is generally premeditated may argue in favor of a strong involvement of cognition in the act. However, we do not know how such cognition fits into the causation of suicide and whether particular cognitive patterns are a necessary link in this causation or simply attendant circumstances not involved in the causative chain.

It is thus difficult to conceive of a mechanism whereby the development of a relatively sophisticated conception of death could *on its own* account for suicide and its social ecology. However, acting in synergy with other factors, such a conception could be critically involved in both the history of human suicide and its etiology in particular individuals. As the development of various technologies enabled people to act upon their environment in novel fashions, the concurrent evolution of cognition may have made the infliction of death upon oneself using these technologies conceivable. Primitive humans might have realized that their implements could be used for suicide as well as for hunting, murder, and other acts. The ability to contemplate suicide might on its own entail the ability to perform it, although this ability would not provide motivation or incentive. One qualification here is that even the adult human conception of death is not necessarily clear nor sophisticated, as is evident in the many contradictory notions of an afterlife that occur in different cultures.

Imitation and Vicarious Learning

There is growing evidence that the processes known variously as imitation, modeling, or vicarious learning are involved in suicide. Such processes

may not only help to account for the etiology of individual suicides but also for the diffusion of the behavior through human culture.

Bandura (1971a,b) has provided the most thorough discussion of vicarious learning processes. He argues that much of human learning occurs through the observation of the behavior of others and its consequences. He presents a considerable amount of data suggesting that the probability of a particular response is raised simply by observation of that response in others. Vicarious learning may also occur in a variety of manners that parallel simpler learning processes such as operant and classical conditioning. For example, the probability of an individual's response may greatly increase when that response is observed being reinforced in others, whereas it may decrease if the response is observed being punished in others. Bandura argues that vicarious learning is probably the major mode of response acquisition in humans. That is, the learning of new responses by human individuals may most frequently occur through the observation of other individuals' behavior. To this we might add the fact that humans can communicate to one another verbally and thus influence the probability of future responses. Verbal communication allows rapid learning of responses without direct experience or observation of direct experience.

Clustered Suicides

It is often reported that human suicides are clustered in time and location. Studies indicate that the frequency of suicide may increase following reports of suicide in the news media or following the suicide of friends (Hankoff, 1961; Phillips, 1974). Often the same method is employed in such a cluster of suicides, suggesting that later cases have been influenced by previous cases. It must be noted, however, that the majority of suicides may be relatively isolated events that do not occur in such clusters. Also, stress and personal difficulties may have been present in each case within the clusters, suggesting that modeling or imitation may be ancillary rather than primary causes of the individual cases.

Vicarious learning clearly appears to be involved in the mass suicides that have occurred at various points in history. Although suicide appears to have been less common in Jewish culture than in other cultures, there are a number of instances of mass suicide in Jewish history, as cited in Chapter 3. The mass suicide in Jonestown, Guyana in 1978 is another clear example. The simultaneous suicide of several hundred individuals must indicate a major contribution of learning and imitation. Vicarious learning clearly modifies the probability of suicide and may determine its physical and temporal location as well as its method. It may not, however, by itself provide sufficient motivation for suicide. In the Jonestown case, for example, many of those

attracted to the cult may have experienced some stress, desperation, and inclination toward suicide before joining. Also, threats to the continued existence of the cult and its lifestyle were present at the time of the Jonestown incident; these may have increased the stress and motivation toward suicide in individual cases. Historical records also suggest that the mass suicides in Jewish history occurred when some major misfortune was impending (cf. Chapter 3; also Dublin, 1963; O'Dea, 1882). Also important is the fact that many of the "suicides" in these cases may actually be murders.

De Cieza de León (1959), writing in the sixteenth century, described an interesting incident of mass suicide among the Incas. When conquest of the valley of Aburra by the Spaniards was imminent, "the natives took such a horror of us that they and their women hanged themselves from the trees by their hair or belts [p. XL]."

Vicarious Learning and Nonclustered Suicides

Apart from clustered and mass suicide and on a larger scale, the previous patterns of suicide in a culture may in part determine when, where, and in whom suicide will occur. Previous suicides in specific circumstances may serve as models, teaching members of a culture that suicide is appropriate if similar circumstances are encountered. Vicarious learning may accordingly be involved in the determination of suicides that are not temporally or physically clustered, but which rather relate in terms of motives and personal circumstances. Imitation and modeling are frequently cited as influences in child and adolescent suicides, in that a suicide or suicide attempt by a relative or acquaintance may lead the individual to copy the example (cf. Seiden, 1972).

Vicarious learning might also help to account for cases of culture-specific methods and circumstances of suicide. One example is the ancient oriental custom of suttee, the self-immolation of a woman on her husband's funeral pyre (Venkoba Rao, 1975). While high rates of suicide occur among widowed individuals in other cultures (Linden & Breed, 1976; see also Chapter 5), an especially high frequency of this act in prescribed circumstances in one culture suggests a strong role of imitation. A more unusual illustration of this point comes from Firth's (1961) description of suicide in Tikopia. Although the method of hanging is found throughout the globe, in Tikopia it is accomplished in a unique manner. The person fashions a noose from a fishline or other thin cord, then rushes to the end of the house, which apparently brings death fairly quickly. Moreover, a curious fastidiousness is often displayed about the act, with the person refraining from food intake for a day or so before committing it. This is done to avoid leaving the house in a mess, because apparently those dying through this act excrete freely. However, unique or unprecedented methods are also found in most cultures. One case

in Tikopia was that of Pu Sao, who having broken wind in a public gathering, in his shame climbed a coconut palm and sat down on the sharp-pointed, hard flower spathe, which pierced his fundament and killed him.

The possibility that religious and social strictures against suicide, such as those of Mohammedanism and Catholicism, act to reduce the act (cf. Dublin, 1963) may provide further evidence of the role of social learning in the etiology of suicide. A similar argument could be made for the converse case, where suicide has been viewed as a respectable or honorable deed, as in Japan (Iga & Tatai, 1975) or ancient Greece (Rosen, 1971). As was argued in Chapter 3, suicide occurs at an appreciable rate in most cultures regardless of social attitudes toward the act. However, social attitude may act as an ancillary determinant of the probability of suicide (see Chapter 11). Individuals may be influenced by teachings of adverse or favorable consequences of the act in an afterlife or to their remembrance after death. Although it is difficult to conceive of any manner in which such hypothetical consequences could affect the individual's biological fitness, a human susceptibility to the suggestions of others may prevail here. Also, to the extent that the favorable or unfavorable remembrance of an individual may affect surviving kin, the consequences for biological fitness imposed by a society may be real.

Vicarious Learning and Social Ecology of Suicide

Vicarious learning could also possibly account for recurrent patterns in the social ecology of suicide, insofar as individuals might be more inclined toward suicide as their personal ecological circumstances approaches those of others known to have committed suicide. However, there is no obvious reason why vicarious learning alone would lead to any particular social ecology of suicide, yet there are strong patterns in its proximate motivation and ecology that are seemingly common across cultures. Vicarious learning alone may not explain the fact that suicide predominantly occurs in those with a reduced capacity to behave toward their inclusive fitness. It seems likely that some other variables interact with such learning to account for the motivation and ecology of suicide.

It is conceivable that the collective experience of a culture, combined with conceptions of the nature of adaptation that are influenced by innate and experiential factors, could help to limit the occurrence of suicide to situations in which it is effectively not maladaptive. Every individual has some conception of the nature of adaptation, in that most of his or her behavior and the behavior of others observed serves to promote it. In learning of previous suicides and their circumstances, individuals could form some judgment as to whether the acts affected any potential residual biological fitness held by the suicidal individuals. Although they might not verbally express it in such

terms, individuals learning of the suicides of others may view these as maladaptive or irrational when some recourse to adaptive behavior was available to the individual or when some adverse effect on inclusive fitness occurred as a consequence of suicide. Consequently, individuals may selectively imitate suicides that occur in circumstances of low biological fitness.

Summary and Conclusions

There is fairly clear evidence that learning, cognition, technology, and culture play a role in the determination of suicide. Furthermore, developed human cognitive and learning abilities may at least in part account for the uniqueness of human suicide in the animal kingdom. The major issue is whether cognition and learning are primary or secondary causes of suicide.

It is quite plausible that suicide originally began to occur in human evolutionary history as various technologies for effecting death proliferated. This may have been facilitated by knowledge of death and a realization that we have the capacity to effect our own deaths. These factors would add to the human behavioral repetoire the capacity, but not the motivation, to commit suicide. Regardless of the motives for which suicide originally began to occur, it could diffuse as a practice through human culture because of imitation and social learning.

As was discussed in Chapter 5, the motivation and social ecology of suicide are inextricably related; suicide occurs predominantly where it has relatively little effect of extracting genes from the gene pool, hence where it is least maladaptive. It is unclear whether this aspect of suicide can be entirely explained in terms of learning, culture, cognition, and technology. One conceivable mechanism would involve a complex synergy of cultural conceptions of the nature of adaptation, cognition, and selective imitation. However, as will be discussed in the next few chapters, biological factors are probably also involved in this synergy.

7

Stress, Pathology, and Suicide

To this point I have discussed the behavior of organisms as if it should be adaptive under all but the most unusual circumstances. This generalization does not entirely hold. Any perusal of a text on abnormal human behavior (e.g., Davison & Neale, 1978; Duke & Nowicki, 1979; Harmatz, 1978) will indicate that behavioral maladaptiveness is not uncommon in the human population.

As was argued in detail in Chapter 1, an individual should usually be structured from birth such that his or her behavior promotes adaptation. This is true insofar as such an individual inherits factors predisposing toward adaptiveness due to generations of selection, and insofar as these factors are expressed within environments like those in which they were selected. There is increasing evidence of mechanisms predisposing toward adaptive behavior in humans; these probably have a partial basis in polygenic inheritance (cf. Chapter 1). The interaction of inherited predispositions with normal cultural and learning experience should generally ensure that an individual's behavior operates to promote inclusive fitness.

There are several circumstances under which an individual's inherited predisposition might not be expressed so as to favor adaptation. These circumstances are generally those subsumed by the common notions of *stress* and *pathology*. In this chapter I would like to examine these circumstances and the extent to which they might contribute to the incidence and social ecology of suicide. In a sense this analysis may seem contrary to that of Chapter 5, in that we will return in part to the notion that suicide is maladaptive. However, these two discussions can be reconciled in two manners. First, the factors of stress and pathology may in large part account for the antecedent conditions of suicide, or factors which reduce an individual's

capacity to promote inclusive fitness. These factors would include coping difficulties; the coping difficulties in turn may predispose toward suicidal motivation through various mechanisms discussed elsewhere in this volume. Accordingly, these factors would indirectly account for the observed social ecology of suicide. Second, factors of stress and pathology may more directly be involved in the etiology of maladaptive cases of suicide. As such they may account in large part for the exceptions to the generalization that suicide occurs where it has minimal negative effect on the gene pool; they may account for cases where some fitness is lost through suicide.

Maladaptive States and Inheritance

I would first like to discuss some general reasons why the inherited structure of an individual may not necessarily favor that individual's adaptation.

Mutation

Novel genes may arise in the gene pool in the course of evolution. These "mutations" consist of sudden, heritable changes in the structure of genetic material (Srb, Owen, & Edgar, 1965). Mutations provide some of the raw material with which selective pressures work to bring about evolutionary change. The process of mutation is, on the whole, adaptive, since it allows genetic change and speciation, which adapt organisms to ecological and environmental changes occurring over generations. Indeed, the number of mutations in a population may increase with exposure to harsh and novel environments (Srb *et al.*, 1965), which may hasten adaptation to transitions in the environment. Despite the adaptiveness of the overall process of mutation, there seems to be agreement among geneticists that the majority of mutations probably induce maladaptive traits. It is conceivable that mutation affecting traits controlling behavioral development could induce maladaptive behavior.

It seems quite unlikely, however, that mutation could directly account for the phenomenon of suicide. Suicide occurs too frequently in the human population for the majority of cases to be due to novel genes; it is unlikely that novel genes favoring a single behavior pattern could arise independently in so many cases. Furthermore, Chapter 6 suggested that cultural and technological change may more readily account for the origin of suicide.

Pleiotropy

Any single gene locus may affect more than one phenotype. Consequently, there may be differential adaptiveness of various phenotypes af-

fected by a gene. In some instances one or more very adaptive traits may be induced by a particular allele, but other less adaptive traits may also be induced. If a maladaptive trait is a necessary part of the set of traits affected by a gene, the gene may nonetheless prosper in the gene pool on the basis of more adaptive traits it also favors. The positive traits accordingly outweigh the negative. Maladaptive behavioral predispositions may recur in the population because they are a necessary part of some overall adaptive genotypic and phenotypic complex.

D. S. Wilson (1980) emphasized the possibility that pleiotropy could be involved in suicide in his response to my recent article on that topic (deCatanzaro, 1980). There are indeed a number of aspects of suicide that could be subsumed by this notion. One is the possibility, discussed in Chapter 6, that learning processes and behavioral flexibility may carry with them the occasional by-product of maladaptive learning. Pleiotropy may similarly be relevant to the gene-expression notions to be discussed in the remainder of this chapter and much of Chapter 8.

Recessive Lethals and Heterozygosity-Homozygosity

Phenotypes may also be dependent upon heterozygosity or homozygosity of alleles, with homozygosity in some cases predisposing toward maladaptiveness while heterozygosity favors some adaptive trait. An example of this principle comes from the sickle-cell hemoglobin trait. In the homozygous state, this allele is extremely disadvantageous, producing anemia, visceral damage, and early death. Yet this allele is maintained at a relatively high frequency in many populations of the world. The heterozygotes are at much less of a disadvantage; indeed, it has been argued that they possess an advantage in areas where malaria is endemic (Srb *et al.*, 1965). Since the allele would most frequently occur in the heterozygous state, the advantage it confers in this state may outweigh the deleterious effect of the occasional occurrence of homozygosity. Similarly, it is conceivable that alleles predisposing toward maladaptive behavior in the homozygous state could continue to be carried in the population because they favor adaptiveness when in the heterozygous state. A specific involvement of this factor in suicide is not entirely inconceivable but there is no evidence to support it.

Genetic Recombination and Genetic Milieu

The adaptiveness of an allele may in other manners depend on its genetic context (Caspari, 1967; Herskowitz, 1973). The allele may be favored by selective pressures because it predisposes toward some adaptive behavior in most of the recombinations in which it occurs. Occasionally, however, its genetic milieu may be such that it favors a maladaptive trait. It would

continue in the population, despite the fact that it occasionally induced a maladaptive phenotype, because its usual effect was adaptive. A maladaptive behavior could consequently have a genetic basis yet recur in the population.

It is known that affective conditions, particularly states of depression, dysphoria, or despondency, relate to suicide (Beck, Kovacs, & Weissman, 1975; Farber, 1968; Lester, 1972b; McCulloch & Philip, 1972; Wetzel, 1967a). There is also evidence that tendencies toward depressive conditions are under the influence of polygenic inheritance (Fuller & Thompson, 1978; Gershon, 1978; Gershon, Bunney, Leckman, Van Eerdewegh, & DeBauche, 1976). A tendency to become dysphoric in times of mild stress may be adaptive insofar as it facilitates response inhibition and problem solving behavior. However, in some individuals such as a tendency may be exaggerated because of the particular gene recombination they inherit. To the extent that excessive dysphoria facilitates suicide, gene recombination may be involved in suicide. I will return to a discussion of genetics and suicide in Chapter 8.

Environmental Stressors, Gene Expression, and Maladaptiveness

Let us now consider how environmental conditions may induce coping difficulties and states of maladaptiveness in organisms whose genetic constitutions would normally favor adaptation. It is well-established in the discipline of genetics that gene expression is dependent upon the environment in which it occurs (e.g., Caspari, 1967; Herskowitz, 1973). A phenotype may differ with the environment despite the constancy of the genotype, as for example the skin of Caucasians darkens with exposure to ultraviolet light. The adaptiveness of the phenotype (and consequently the genotype) is similarly dependent on the environment. For example, genes favoring light-colored skin may be adaptive within temperate climates, but within tropical and equatorial climates they may be less adaptive than genes favoring darker skins. Genes increase in frequency when they predispose toward adaptive traits within a specific range of ecological circumstances. Outside of these ecological circumstances, there is no reason why they should necessarily predispose toward adaptiveness. Therefore, in highly novel environments, we might predict the possibility of maladaptive characteristics, since gene expression should be adaptive only within the range of circumstances in which the genes have been selected. When an individual is outside of the natural habitat or ecology for that individual's species, there is no reason why behavior should be adaptive; indeed, a priori, we might expect that it could be maladaptive, since predispositions af-

fecting behavioral development might not produce suitable behavior in an abnormal environment.

A strong argument can be made that modern suicides are facilitated by novel environmental conditions. Human culture and technology have undergone such dramatic changes in the past few centuries that increasingly there should be some lag between genetic evolution and cultural conditions. Indeed, humanity has been in some transition throughout recorded history; this transition may have accelerated with the recent industrial and technological revolutions. Consequently, we should expect that individuals are increasingly exposed to environments for which they are not biologically prepared.

Novel Environments and Human Technology

Consider again the methods of suicide. As was discussed in Chapter 6, many of the current methods involve modern technologies. The availability of many of these methods is a novel contingency for which we could not possibly yet be biologically adapted. Such methods may facilitate suicide because they are readily available. There are poisons, cutting implements, and often firearms available within many modern households, while automobile traffic and other potential instruments of death are usually not far away. Such instruments may particularly facilitate relatively impulsive acts of suicide. Given that many of these instruments have only been present for a brief period in an evolutionary time scale, it is quite unlikely that there would have been any complete biological adaptation to their presence.

Furthermore, many of these implements facilitating suicide would overcome natural mechanisms that normally inhibit self-destruction. Pain mechanisms are a clear example. Most individuals would not engage in many potential forms of self-damaging behavior because they possess reflexes causing them to avoid them. Yet many modern methods of suicide, especially those involving barbiturates, other narcotics, and firearms, are relatively painless. These methods bypass natural inhibitory mechanisms that have a very long evolutionary history; members of most species actively avoid simple physiological insults. But it is quite unlikely that there has been an adequate amount of evolutionary time for new reflexes to arise to cause avoidance of complex new methods of self-injury.

However, some counterarguments and qualifications are necessary here. If modern technologies had greatly facilitated suicide, we would expect there to have been a fairly substantial increase in the suicide rate in recent years, yet this may not have been the case. In the 1890s in England and Wales, suicide occurred at about the same rate as today, with hanging, drowning, and stabbing being most common (Littlejohn, 1910-1911); in 1965

analgesics, narcotics, and domestic gas were most common, with hanging and drowning being much lower in the hierarchy (Stengel, 1973). It appears that what has changed is the methodology rather than the frequency and motivation of the act. Similarly, we would predict that suicide would be much less common in technologically unsophisticated cultures than in those that are technologically modern. The review presented in Chapters 2 and 3 may give some support for this, although the issue is far from clear. It appears that suicide occurs through relatively simple technologics at a fairly high rate in some technologically less advanced cultures. The rates from more technologically advanced cultures may be somewhat higher, but this may be confounded by differences in the reliability of the data. Certainly some of the highest rates in the world today, for example in central Europe and Japan, are in areas that are relatively advanced in technology, but these are also areas that have traditionally had high suicide rates. Some of the lowest rates, such as those of Nigeria or Moslem countries, are in technologically less advanced areas, but there are several competing hypotheses to account for these low rates that I have discussed elsewhere. Another consideration is that even if there is an increase in suicide rates found in modern times or more technologically developed countries, there is an increase in the life span in modern countries, which, as will be discussed later, on its own may increase the suicide rate. It is thus difficult at this point to determine precisely the extent to which modern suicide rates are facilitated by technological change.

It could be argued that we have not yet adapted even to some of the older technologies of suicide, such as hanging, which would have developed with the technologies of clothing and rope. However, so many generations have passed that such arguments might be weak. Also, self-drowning and self-exposure to harsh elements require little technology, as was discussed in the last chapter. We must also consider here that the arguments of Chapter 5 suggest that suicide is not maladaptive in many, perhaps the majority, of its instances; it occurs largely where it does not extract genes from the gene pool. Thus, the adaptation that has occurred to technologies of suicide may not have been an elimination of its occurrence, but rather a restriction of its occurrence to where it is least maladaptive. One might accordingly predict that technologically older methods of suicide would usually be associated with less maladaptive cases of the act occurring where biological fitness is low. Modern technologies might be involved in more impulsive and more maladaptive cases. Thus, it might be hypothesized that current exceptional cases of suicide that produce a loss of biological fitness would most frequently involve modern technologies, which is a testable hypothesis. However, it is difficult to conceive of how inherited mechanisms might specifically affect the tendency to employ specific technologies in the act of suicide. Inherited mechanisms could conceivably affect motivational conditions involved in

suicide, but learning would seem necessarily to be involved in the choice of the technology employed in the act.

Other Environmental Novelties

There have also been major transitions in the modern social environment that might have increased the frequency of coping failure. It has probably been most common in human history for individuals to live in relatively stable communities containing a large number of kin, as occurred for example in hunting and gathering or primitive agricultural societies. Such an environment might have been much less conducive to social isolation than would modern urban environments. It would also have allowed many more opportunities for an individual to behave toward the benefit of kin. There are several other facets of modern life that involve deviations from conditions that have prevailed during human evolutionary history. For example, modern occupational roles are more varied and often more demanding and accordingly may subject some individuals to a considerable amount of stress. Technologies may have facilitated coping in many respects, but may also have had adverse effects because biological adaptation to them remains incomplete. Presumably, there is a considerable amount of tolerance of environmental novelty in the human biological constitution engendered by our ability to learn, but a minority within each generation may experience situations that are sufficiently aberrant that effective coping is rendered impossible.

The sociologists have argued since Durkheim's work that suicide frequency is related to social instability (see Durkheim, 1951; Gibbs, 1957; Henry & Short, 1954; Meer, 1976). Social instability may increase the frequency of coping difficulties in the population; some individuals may be exposed to social contingencies for which they are not prepared. The relationship of such coping failure to suicide may most often be indirect; coping failure of any sort may change the motivational structure such that the act of suicide becomes possible. In some cases, however, suicide might itself constitute the coping failure, in that the individual might have been able to cope if he had not committed the act. This latter situation holds, for example, where suicide occurs as an impulsive act facilitated by the availability of some novel technology.

The inheritance of an adaptive genotype does not prevent the occurrence of damage or malformation through harsh or extreme environments. Numerous factors are known to affect human growth and development adversely (e.g., see Davison & Neale, 1978; Knopf, 1979). This includes damage, at any time following conception but especially during fetal development and early childhood, due to physical trauma, toxins, nutritional

deficiencies, inadequate parenting, inadequate stimulation, social isolation, psychological trauma, and so on. Such conditions involve development in adverse or novel environments, and consequently there is no reason to expect adaptiveness of behavioral and/or physiological attributes.

Within each human generation there is some competition among individuals for resources. This competition may occur even in the absence of major social transitions, although a scarcity of resources and cultural change would accelerate its pace. Individuals compete for reproductive relationships from adolescence onward (see Daly & Wilson, 1978; Symons, 1980). Some individuals are relatively successful in obtaining stable reproductive relationships with others that will facilitate their ability to propagate their genes. A minority within each generation fails to establish successful mating arrangements, which may reduce the ability to promote inclusive fitness. Success in mating seems to be contingent upon several characteristics, including the general physiological, social, and economic viability of individuals (Symons, 1980). Individuals also compete in economic and social settings for position, influence, and economic rewards that in several manners facilitate the promotion of inclusive fitness. Coping failure in some individuals within each generation may thus be inevitable as competition excludes them from access to means for promoting fitness.

Another novel condition found in modern societies is the fact that the life span has been increased by medical and nutritional improvements (see Lester, 1980; Retherford, 1975). This would again mean that genes in later ages are often being expressed in conditions unlike those in which they have been selected. This would accord with the high rate of suicide found among the elderly in technologically more developed parts of the world (see Chapters 3 and 5). There would be no reason to predict behavioral adaptiveness in old age to the extent that survival to such age is historically novel. In Chapter 8 additional contingencies of selection affecting gene expression and behavioral adaptiveness in old age will be discussed.

Suicide and Psychopathology

One recurrent issue in discussions of suicide, the relationship of suicide to other forms of psychopathology (e.g., Lester, 1972b, Sletten, Brown, Evenson, & Altman, 1972; Stengel, 1973; Temoche, Pugh, & MacMahon, 1964), is relevant here. Estimates of the number of suicides involving psychiatric illness vary widely. There is substantial evidence that the frequency of suicide among psychiatric populations is greater than in the population at large. However, Stengel (1973) estimates that only one-third of those committing suicide have been under psychiatric treatment, sug-

gesting that we cannot form generalizations about the relationship between suicide and mental disorder without some expansion of the latter concept. Lester (1972b, 1980), however, makes an estimate of the number of suicides associated with mental disorder as high as 94%. Clearly, the definition of "mental disorder" or "psychopathology" is critical here, which reduces the argument to one of semantics. Many mental disorders, such as schizophrenia, are poorly defined; the reliability of specific diagnoses among different clinicians is low, while the individuals placed within such diagnoses are often very heterogeneous in behavioral characteristics (Davison & Neale, 1978). While those diagnosed as schizophrenic may show a somewhat higher incidence of suicide than members of the general population, it is difficult to determine what this means.

At least two distinct modes of causation might be involved in a higher incidence among those diagnosed as mentally ill. First, the suicide may occur as a direct component of the mental illness, in which case we might classify the suicide itself as a form of pathology or maladaptiveness. Second, and consistent with many of the arguments elsewhere in this volume, because the individual is already mentally ill through malformation or damage, capacity to promote his or her genes may be reduced. Consequently, like any other individual with coping problems, the mentally ill individual may perceive little reason to continue to live, and may commit suicide for the same reasons that others with coping problems do. Both of these causative chains could be involved in suicide, the balance between the two depending on the particular case.

In any event, a consideration of the relationship of mental illness or psychopathology to suicide is obscured by the fact that those studying such conditions have not clearly defined the relationship of these conditions to biological adaptation. For example, what may constitute an affective disorder to a clinical psychologist or a psychiatrist is a *disorder* only relative to the psychologist's or psychiatrist's value system. To a biologist, it may be fairer to consider it as an affective or motivational *condition*, the adaptiveness of which can only be defined by a thorough consideration of its relationship to the individual's inclusive fitness.

Rate of Adaptation to Harsh and Novel Environmental Contingencies

In general, we can conclude from this discussion that coping failures occur due to discrepancies between the inherited capacities of an organism and the environmental contingencies to which it is exposed. Environmental novelty and competition may ensure that coping failures occur at some rate within

each generation. Under stable environmental conditions the rate of coping failure should be much lower than under less stable conditions. The nature of coping failure varies widely among individuals, depending on their weaknesses and the nature of the harsh environment to which they are exposed. Genetic variance and recombination ensure some degree of tolerance to novel conditions, but also themselves engender some coping failures.

The rate of adaptation of a species to novel and harsh environmental contingencies over generations may depend on several factors, including the frequency of the particular maladaptive gene-environment combinations, the nature of the maladaptiveness, and the selection factors imposed. This rate may be critical for our interests in human suicide and self-damaging behavior. It may take numerous generations for an infrequent event to be affected by selective pressures. Also, if the event does not substantially affect the fitness of individuals, it may not impose a sufficiently strong selection pressure for rapid adaptation to occur.

As was argued in Chapter 5, suicide in many of its instances does not impose a major selection pressure, in that it occurs after inclusive fitness has already been substantially reduced. However, there must be some cases where some fitness is lost through the act, especially where it occurs among younger individuals with potentially transitory coping difficulties. Also, insofar as suicide is facilitated by novel technological, social, and other cultural conditions, biological adaptation to it is incomplete. There is insufficient knowledge about the relationship of parameters of frequency and intensity of maladaptive conditions to the rapidity of biological adaptation over generations. It is conceivable that numerous generations would be required for full adaptation of a population to events of the nature of suicide. The rapid transitions in human culture and ecology may render adaptation to the act difficult, especially insofar as it may continue to occur in novel circumstances as the culture changes. Furthermore, the fact that learning may be involved in the etiology of the act may make it difficult for innate attributes to develop to prevent its occurrence.

Pathogenic Conditions, Culture, and the Social Ecology of Suicide

Human technology and culture have led to a greatly expanded behavioral repertoire; suicide is one of several behavioral patterns that have been facilitated by this expansion. Predominantly, suicide occurs after some major coping failure has occurred and where prospects for future coping appear to be poor. Cultural transition has facilitated many coping failures by placing individuals in environments for which they are not biologically prepared, and

the orientation of behavior toward survival may accordingly break down in such environments. Suicide can recur in situations of coping failure over generations because the act itself may not adversely affect the inclusive fitness of those who display it. If suicide occurs only in individuals that have already experienced severe coping failure, it may not present a major selection factor. As long as it does not delete reproductive potential from the population, it is not biologically maladaptive and can continue to recur over generations.

The conditions conducive to coping failure described in this chapter may in these cases induce suicide only in an indirect manner. These conditions may lead to coping difficulties that may take a variety of forms, dependent on the specific weaknesses of the individual and the form of the environmental demand. Under a strict biological definition, an individual who is failing to cope is one who has lost the capacity to promote his or her inclusive fitness. If individuals perceive that they cannot promote their interests, their motivational structure may change, for reasons described in other chapters, such that suicide may be contemplated.

However, in many cases suicide may occur where coping failure is incomplete. Although an individual is experiencing some difficulty in promoting his or her inclusive fitness, the difficulty may be potentially transitory. This may especially be true of some of the completed suicides occurring among young people. In these cases an individual may conceive of the coping problem as insolvable, although in absolute terms this may not be the case. The coping failure may exist only relative to some unrealistic standard that the individual has set for himself or herself, or that had been set for the individual by others who influence his or her cognitive structure. Some aberrant learning experience may also affect the individual, as might be the case when coping failure is perceived where one does not exist or if the suicide of another individual is imitated when the individual's own coping difficulty is not severe.

In these cases, the act is more maladaptive in a biological sense. It is thus a form of pathology itself, and many of the general factors discussed in this chapter may be contributing to its occurrence in a relatively direct manner. The fact that selection pressures have not acted to prevent the recurrence of such suicides may be explained by several of these factors. The historical novelty of the circumstances of some suicides may reflect a lag between cultural evolution and biological evolution. Because of the involvement of learning and culture in the etiology of the act, and insofar as the frequency of such suicides may not have been sufficiently high for a sufficient number of generations, selective pressures may not yet have been adequate to prevent such maladaptive suicides. Additional factors conducive to maladaptive suicides will be discussed in subsequent chapters.

8

Coping Failure, Senescence, Gene Expression, and Suicide

This chapter extends the consideration of gene expression conditions begun in Chapter 7. The factors to be discussed here are intimately related to the notion of stress-induced changes in gene expression, but elaborate upon it through a consideration of aging, senescence, and reproductive potential. This should further account for the social ecology of suicide. The occurrence of suicide in those with reduced capacity to promote their inclusive fitness suggests an alignment of the act with evolutionary contingencies. This chapter will suggest the possibility that innate factors contribute to suicidal motivation, although it is clear that such factors would have to interact with learning, cognition, and culture.

Freud (1924) spoke of a "death instinct," which motivated an individual to seek death when it surfaced under particular environmental and psychic conditions. This speculation was not based on a broad spectrum of evidence, and the notion of such an instinct has not proven to be popular, even among many of those with training in psychoanalytic theory. However, Menninger (1938) did develop and extend the notion to explain a wide variety of self-damaging behavior patterns. Most researchers appear to assume that any human "instincts" or innate behavioral predispositions act to advance the individual's existence. This is perhaps in part due to inexplicit assumptions about evolutionary processes. Superficially, an involvement of innate factors in suicide seems quite implausible. As Skinner (1969) reasoned, any mutation supporting suicide would rapidly eliminate itself. Consequently, he suggested, suicide must entirely relate to learning experience.

Prosuicidal Gene Expression and Natural Selection

In Chapter 7 it was discussed how certain gene-environment interactions could induce maladaptive or pathological conditions which might

facilitate suicide. This is probably also very much in tune with common conceptions of the origin of suicide. Most people would probably accept the notion that aberrant conditions and stress are involved in suicide. The reasoning in the previous chapter tied this to a variety of pathogenic forms of gene-environment interaction.

There is an additional manner in which gene expression may relate to suicide, and one which may make the notion of an involvement of innate factors in suicide more plausible. Skinner in his reasoning overlooked a critical consideration. Gene expression may change with the phase in the life cycle and with an individual's life circumstances. Dependent upon coping status, the effects of gene expression are likely to differ, because the selective pressures that would shape gene expression vary substantially with an individual's capacity to promote his or her inclusive fitness.

Suppose that through mutation or expression in novel environments, a gene came to favor life-threatening behavior in some subtle or indirect manner. If such a prosuicidal gene expressed itself when individuals retained a capacity to promote their inclusive fitness, it would indeed be deleterious and soon eliminated from the gene pool. Its elimination could be immediate if it were expressed in childhood or early adolescence, because it would prevent reproduction and thus not be passed on. If it were expressed after reproductive age had begun, but before the individual had done all in his or her power to nurture his or her children, it would also be deleterious because it would threaten the viability of those children. Under such circumstances it might fail in competition with other genes in the population favoring survival until nurturance of offspring was complete. If the prosuicidal gene were expressed in individuals excluded entirely from reproduction but who retained a capacity to work toward the benefit of reproducing kin, it would also be deleterious. This would be true because it would adversely affect the reproduction of those kin, who would share the gene but in whom it would not be expressed. But if the gene were expressed after reproductive ages had passed and where the individual no longer had a capacity to nurture reproducing relatives, no selection pressure would act to eliminate it. Similarly, if it were expressed in younger individuals that were permanently excluded both from reproducing and from contributing to the welfare of reproducing kin, no selection pressure would act to eliminate it.

In short, a prosuicidal gene expressed only in individuals without a capacity to promote their inclusive fitness would continue to exist in the population. In other words, if such a gene were expressed only in individuals with unsolvable coping problems, it would not be eliminated from the population by natural selection. Direct or indirect reproductive potential would not be reduced by the gene's expression in such circumstances. For statistical reasons, it might be expected that gene expression conditions of this sort

might have occasionally arisen during evolution. As long as these gene expression conditions occurred only where they did not reduce the individual's inclusive fitness, they could accumulate in the population gene pool over generations. It is thus conceivable that there is a polygenic basis for suicide arising only after permanent coping failure has occurred.

The involvement of pleiotropy might increase the selective pressures favoring the transmission of any genetic factors associated with prosuicidal tendencies. Any new mutation is likely to have many different effects. These effects may differ with the stage of the life cycle, being different during fetal development, childhood, adolescence, adulthood, or old age. If a mutation has a beneficial effect at one particular stage of the life cycle, its effects may be disadvantageous at other stages because disadvantageous effects of mutation are more probable than advantageous effects (see Dawkins, 1980). A gene is selected for any effects it has prior to and during reproductive ages. However, its effects in old age should not affect selection, no matter how beneficial or deleterious such effects are at that stage. Similarly, its effects at younger ages in individuals who have lost the capacity to promote their inclusive fitness should not be affected by selection, no matter how much these effects favorably or unfavorably affect the individual's health. Genes will be selected only to the extent that they alter direct or indirect reproductive potential. Through pleiotropy new mutations that are beneficial before or during reproductive activity may prosper in the gene pool, despite the fact that they may be expressed in deleterious manners in postreproductive ages or in young adulthood when direct or indirect reproductive potential is permanently lost.

Prosuicidal gene expression that occurred where some incomplete coping failure existed might be deleterious, but insufficiently so for the gene to be rapidly eliminated from the population. For example, such an incomplete coping failure may occur in nonreproducing or postreproductive individuals with only a marginal capacity to work toward the benefit of reproducing kin. It might also occur among young people with repeated failures in reproductive and productive endeavors, but whose coping failures are potentially transitory. There may be some loss in inclusive fitness through the suicide of such individuals, but the loss is not adequately great for selection, within a few generations, to act against prosuicidal gene expression in such circumstances. Prosuicidal gene expression could thus recur in such circumstances over generations, although ultimately, given stable ecological conditions for several generations, such expression would cease to occur. Prosuicidal genes expressed in those with partial coping failure might accumulate in the population in times of ecological instability. Prosuicidal gene expression in individuals with partial coping failures might be facilitated by the similarity of these failures to more complete coping failures, where such

gene expression could occur unimpeded over generations by selective pressures. Thus, a polygenic basis for suicide occurring in those with partial coping failures is conceivable, especially in times of unstable ecological conditions.

Prosuicidal gene expression could very occasionally occur in individuals retaining a strong capacity to promote their inclusive fitness or without serious coping failure. This might be favored by mutation, gene recombination, or expression of genes in novel environments. But the serious loss of reproductive potential in such circumstances would ensure that such suicides would be relatively infrequent. Any genetic factors favoring suicide in such conditions would be rapidly eliminated from the population.

In summary, a consideration of the interaction of selective pressures and hypothetical prosuicidal gene expression perfectly predicts the observed social ecology of suicide that was discussed in Chapter 5. More than any other factor that I have discussed, this consideration could explain why suicide occurs in those with a reduced capacity to promote their inclusive fitness. This does not mean that suicide is entirely innate behavior, nor necessarily that there is a strong innate contribution to its etiology, as will be discussed below. It certainly does not even suggest that genetic differences between individuals account for the fact that some commit suicide while others do not. Rather, it makes it more conceivable that there is some direct or indirect contribution of innate factors to suicide that interacts with contributions of learning and culture.

The Medawar-Williams Hypothesis, Senescence, and Death

I should point out that some of these notions rest heavily upon arguments developed by Medawar (1957) and Williams (1957) to explain senescence and death in general. I have extended their notions of mutation, gene expression, and senescence to explain life-threatening behavior, and have also added the idea that gene expression should similarly be dependent on degree of fitness in youth. I also should point out my debt to Dawkins (1976, 1980) for suggesting the relevance of the Medawar-Williams hypothesis to my reasoning.

The gene-expression conditions that I have described as potentially conducive to suicide also constitute conditions favorable to most other modes of death. The Medawar-Williams hypothesis argues that senile decay develops as genes are expressed where reproductive capacity is diminished; such gene expression may no longer be life-promoting and indeed may be conducive to

death. Most commonly we would think of failure of various physiological factors as conducive to death, but there is no reason why behavioral failures cannot be included. It is clear that different individuals die for different reasons in old age, including heart attacks, infectious diseases, strokes, various cancers, or other factors. As modern medicine conquers one mode of death, new modes seem to arise, as cancer is now a prominent cause of death because infectious diseases take less of a toll (Retherford, 1975). These forms of death may all be brought on by gene expression in conditions in which the genes have not been selected or in harsh and competitive situations. It appears that there is a considerable amount of variance among individuals in which bodily system fails first; it is not unlikely that variance among individuals in genotype and exposure to particular environmental stressors is responsible.

If we are to include suicide as simply another form of biological breakdown due to gene-expression conditions, then it should not be surprising that some individuals are more prone to it than others under situations of similar adversity. What may be the occasion for suicide in one individual may be the occasion for death through another mode in another individual. There is no reason to form a strong differentiation between behavioral and physiological diseases and consequent modes of death; both should be subject to the same selective pressures, and behavior is mediated at some level by physiological processes.

In the same manner that organisms become subject to disease and death in old age, they may also become subject to disease and death when in novel environments or when the capacity to promote inclusive fitness is permanently lost in youth. Coping difficulties or stress, which through a biological definition should constitute reduced or threatened fitness, are known to bring about a variety of diseases, including many psychological disorders following a diathesis-stress model (Davison & Neale, 1978; Knopf, 1979). Reduced resistance to disease is known to accompany protracted psychological stress (Selye, 1976). This all suggests that disease and death of various sorts may be hastened by general coping difficulties, since gene expression need not be life-preserving when potential fitness is reduced.

Breakdown of Other Life-Preserving Factors with Coping Failure

It is interesting at this point to note that other failures of adaptive behavior are generally associated with protracted stress, depression, despondency, and coping failure. Beck (1967) has described how depressed individuals fre-

quently fail to engage in normal eating, sleeping, grooming, work, and other self-promoting activity. Sexual activity may also break down in times of protracted stress (deCatanzaro & Gorzalka, 1981). One theory (Seligman, 1975) is that individuals learn, through repeated failures, that coping activity has no effect upon the environment, and consequently cease to engage in it. It is also known that neurochemical conditions change during chronic stress in manners that favor decreased general activity levels (Anisman, 1978; Anisman, Pizzino, & Sklar, 1980; see also Chapter 10). Regardless of which of these proximate mechanisms is more important, on an evolutionary level this motivational change would also be predicted. Once an individual's prospects for future coping have become very poor, there may be no reason why his or her behavior should continue to be oriented toward survival. When coping failure is fairly certain, the expression of any life-preserving behavior patterns may have little impact upon the individual's inclusive fitness. There is no selection pressure favoring the expression of life-preserving behavioral patterns in individuals that are precluded from success in promotion of their inclusive fitness.

Another phenomenon that fits this trend is "sudden death" (see Engel, 1971; Hughes & Lynch, 1978; Lefcourt, 1976; Pruitt, 1974; Wintrob, 1973). This term has been applied to many different forms of death; in most of these cases it refers to death that is totally unexpected and that typically has an immediate onset (Hughes & Lynch, 1978). The phenomenon has gathered interest from animal behaviorists, anthropologists, cardiologists, pediatricians, physiologists, surgeons, and others. Cannon (1942) and Lex (1974) have described "voodoo death," where death is induced in some tribes by spells that give individuals the belief that they are hopelessly entrapped. Richter (1955) and others (see Chapter 4) have investigated a "sudden death" phenomenon among laboratory animals; when these animals are placed in an experimental setting where death is inevitable, they die long before there is any obvious physiological reason. Others have dealt with specific human clinical problems such as sudden infant death (Marx, 1975), alcohol and drug abuse (Keeley, Kahn, & Keeler, 1974), pulmonary dysfunction (Emery & Dinsdale, 1974), and various psychological states (Cappannari, Rau, Abram, & Buchanan, 1975). Although these phenomena are too diverse to be explained by a single factor, a common theme that recurs in many of these discussions of sudden death is the psychological state of helplessness or hopelessness (Hughes & Lynch, 1978). This is very consistent with the arguments made here. If an individual is in a condition of hopelessness or severe coping failure, there is no longer any reason why his or her physiology should support continued existence. Selective pressures are such that gene expression in times of hopelessness need not favor survival.

Other Facets of Death and Senescence

There is a complex balance between the reproduction of individuals in a species and the longevity within any particular generation. It is likely that numerous factors influence the characteristic length of life and the ages of reproduction within a species. To some extent, aging must be due to an inability of nature to produce a perpetually viable being. The viability is probably eroded by environmental changes, perhaps especially by competition from young, viable members of the same species and from members of other species such as disease organisms and competitors for the same ecological niche. Because of such competition, the environment is in constant progression. Some proportion of new recombinations of genetic material have a competitive advantage over the combinations of the previous generation. Within these constraints, reproductive age and life span are optimized by selective pressures.

An important factor in death and the development of pathology is that organisms, like other aspects of nature and many human artifacts, wear with age. Entropy and competition from other agents in the environment ensure that most highly organized entities sooner or later degrade. Reproduction, heterogeneity, and recombination are biological organisms' answers to this impermanency. Longevity in organisms is presumably determined by an optimization of viability, weighing vigor and vitality of youth against experience of age, and including in this "calculus" a cost of time spent in reproduction and nurturance. Senescence and many coping failures in youth derive from wear or loss of physiological integrity with aging as well as from postreproductive gene expression. One of the major determinants of the ages of death, reproduction, and cessation of reproduction in a species is probably the average rate of decay and the differential viability with age that this entails. Once average ages of reproduction and cessation of reproduction have stabilized for a species, decay may be hastened or exacerbated by the failure of selection to regulate postreproductive gene expression (Medawar, 1957; Williams, 1957).

A large proportion of cases of suicide could effectively be characterized as occurring once decay and nonviability have set in. The decay may be disease at any stage of life or old age, and its permanency is apparently the most important aspect for the genesis of self-destructiveness (see Chapter 5). Many other cases where decay per se is not an antecedent of suicide involve a loss of means to propagate genes through direct or indirect reproductive activity. In either case, the individual has lost viability. The loss of viability means that suicide generally would not delete biological fitness nor extract genes from the gene pool, and hence that it is relatively immune to the effects of natural selection.

Genetics and Suicide

In this chapter and Chapter 7, I have suggested several ways in which genetics and gene expression might relate to suicide. Unfortunately, there have been relatively few direct studies of the role of genetics in human suicide, whereas there is a growing number of such studies for other normal and abnormal forms of human behavior (see Fuller & Thompson, 1978). There are reports in the literature of families in which several members have committed suicide (e.g., Shapiro, 1935). Farber (1977) has discussed several reasons for this, citing social and economic forces, vulnerable personalities, imitative behavior patterns, characteristic interactions within a family, and characteristic childrearing styles within a family. However, Farber also notes that it is not impossible that innate characteristics within a family play a role. First, he argues that a "fairly obvious case would be that of inherited bodily deformity or extreme ugliness that would lead to rejections, deprivations, loneliness, depression, and possibly suicide [p. 5]." However, he states that a theoretically more interesting case would involve some inheritance of temperamental tendencies that predispose to suicide under certain conditions of stress.

Affective States and Polygenic Inheritance

As mentioned, there is growing evidence that there are genetic factors involved in conditions of depression (Fuller & Thompson, 1978; Gershon, 1978; Gershon, Bunney, Leckman, Van Eerdewegh, & DeBauche, 1976; Winokur, 1978), which are known to be correlated with suicide (Beck, Kovacs, & Weissman, 1975; Farber, 1968; Wetzel, 1976a). A multiple-gene or polygenic hypothesis appears to account best for the involvement of genetics in affective states. This suggests, therefore, that there indeed are dimensions of temperament that are both influenced by genetics and involved in the determination of suicide. This involvement of genetics in suicide is indirect, but nonetheless agrees with the gene expression notions developed earlier in this chapter. In Chapter 10, I will discuss other aspects of temperament and motivation that are mediated by physiology and which are likely both to be implicated in suicide and partially mediated by polygenic inheritance.

Direct Evidence on Suicide and Genetics

There were some early applications of behavioral-genetic techniques specifically to suicide by Kallmann and his associates (Kallmann & Anastasio, 1947; Kallmann, DePorte, DePorte, & Feingold, 1949). In these studies, the

case histories of suicides occurring in sets of monozygotic and dizygotic twins (11 sets in the first study, 27 sets in the second) were compared. Kallmann suggested that suicidal behavior was not consistent among sets of twins, although there were more cases of concordance among monozygotic than dizygotic pairs. He argued that there were no special hereditary traits predisposing a person to suicide. Instead, he reasoned that suicide was the result of such a complex combination of motivational factors that a duplication of this unusual constellation was very unlikely even among identical twin partners. However, Lester (1968) reanalyzed Kallmann's data using more sophisticated statistics. These statistics supported the notion that inherited factors contributed to suicide. Lester concluded that "it is not possible to dismiss inherited factors in the determination of suicidal behavior on the basis of present evidence. In fact, Kallmann's data suggest that there may well be inherited factors [p. 320]." Lester also pointed out that Kallmann's sample size was inadequate given the frequency of suicide in the population.

Clearly, more studies of suicide that employ techniques of behavioral genetics are needed. It should be noted, however, that such studies address only sources of variance among individuals. They do not entirely test the notion that factors of gene expression contribute to suicide. If genes indirectly predisposing toward suicide were uniformly distributed in the population, there might be no difference between monozygotic and dizygotic twins. A trait that is relatively fixed in the population, as tanning after exposure to sunlight may be in Caucasian populations, may involve environmentally controlled gene expression, but might not yield a major difference in twin studies. The gene expression ideas developed in the present chapter do not require that there be any interindividual differences, although some such differences would be likely if inherited predispositions contributed to suicide. There is a need to differentiate the notions of innate determination from notions of genetically induced individual differences.

Other Indirect Evidence of Genetic Involvement

Sex Differences

As was discussed in Chapters 2, 3, and 5, in most cultures of the world there is a clear sex difference in suicide, with male suicides occurring about two to five times as often as female suicides. Although it is conceivable that there would be factors of experience, learning, and culture that would account for this, a genetic hypothesis is also consistent. It is not inconceivable that certain sex-linked traits would be in some manner conducive to suicide. We should also note that men are generally more frail than women in a wide

variety of behavioral and physiological respects. Certainly the incidence of many behavioral disorders, including learning disabilities, hyperkinesis, childhood schizophrenia, some forms of adult schizophrenia, mental retardation, and several others, may be substantially higher in men than women (Knopf, 1979). Similarly, it is well known that the life span of the average male is usually shorter than that of the average female, with females having greater survival potential from conception onwards (McKusick, 1969; Retherford, 1975). Suicide thus constitutes one of several ways in which men are more inclined to early death than women (see also Chapter 15).

It is not known why men are less oriented toward survival, although one hypothesis seems promising. Since the XY chromosomal complement of males provides only one X chromosome, there are a number of alleles on that chromosome without counterparts. Consequently, a male is *hemizygous* at a number of gene loci, and regardless of the behavior of a gene on this chromosome in females, whether recessive or dominant, it is always expressed in the male (McKusick, 1969). Consequently, males may succumb to X-linked recessive lethals, while the female with two X chromosomes enjoys heterotic vigor. It is interesting that there is some biological compensation for this to maintain a fairly equal sex ratio; 1.30 times as many males as females may be conceived, while 1.06 times as many males as females may be born (McKusick, 1969).

There are, of course, several competing explanations of the sex difference in suicide and general mortality (see Chapter 5). Males are likely subject to greater occupational and reproductive competition than females, whereas modeling and imitation of suicide may affect the sexes differentially. Greater stress due to traditional economic and social roles of males may produce a faster rate of decay, increasing the probability of coping failure and suicide. Nonetheless, it is interesting that suicide fits the general sex difference in viability and survivorship, and that this difference may have a basis in genetics.

Racial, Ethnic, and Regional Differences

As was discussed in Chapters 3 and 5, there are racial differences in suicide frequency that transcend national boundaries and separation in historical time and geography. One clear example is the relatively low rate found both among African and American blacks. There are several factors that might account for this; cultural traditions affecting suicide and differences in reproductive strategies might have persisted over generations of geographic isolation. However, genetic differences are among the defining features of races, and the consistencies in white-black differences across widely separated cultures may be too great to be accounted for by tradition alone. Although American black culture has by no means been assimilated

into the larger American culture, the language and culture may be much closer to the American than the African model. It is interesting to note that the suicide rates from West Africa, an area from which many American slaves were drawn, may be low even for Africa (cf. Asuni, 1962; Bohannan, 1960), although the relevant data are sparse. There has been some admixture of the races in America, which might have raised the American black rate relative to the African rate. Contrary to the normally low black rate is the suggestion by Westermarck (1908) that suicide may have been common among recently enslaved Africans, although Westermarck's sources on this point are unclear. Also, the stresses of enslavement may be exceptional.

Rates among Orientals are high, as may be rates among many of the Amerindian peoples (see Chapter 3), who are believed to be originally derived from Oriental stock. Some of the highest rates are among central and Northern Europeans. These high rates transcend linguistic barriers such as those separating countries like Hungary, Austria, Germany, and Denmark. These high rates also survive emigration to America (Dublin, 1963; see also Chapters 2 and 3, and Table 3.4 on p. 34) and South Africa (see Meer, 1976). Common tradition and lifestyle might account for the manner in which differential suicide rates of individuals from particular world regions transcend linguistic and geographic barriers. However, the importance of vicarious learning of suicidal behavior through language in this process is questionable; suicide is in many cultures has frequently been a taboo topic and contrary to the prevailing cultural values (Dublin, 1963; Lester, 1972a; McCulloch & Philip, 1972; see also Chapter 11), which even within a particular language and region might reduce its diffusion through vicarious learning. The question is whether reproductive barriers are greater or less than linguistic and cultural barriers. Regional and ethnic differences in suicide rate could well be explained by learning and culture, but they are also consistent with a genetic contribution to suicide.

In speaking of possible genetic involvement in racial, ethnic, familial, and sex differences in suicide, I am referring to genetic involvement in the stronger sense, meaning the role of different alleles in interindividual variance. The validity of such a strong involvement of genetics in suicide is not a necessary condition for the "weaker" involvement of gene expression in suicide discussed earlier in this chapter.

Reconciling Gene-Expression and Cultural-Learning Involvement in Suicide

In Chapter 6 I discussed how suicide may have begun to occur in human evolution as tool usage provided new means of effecting death, as human behavior became more flexible, and as people's ability to conceive of novel

acts increased. In Chapter 7 these notions were expanded by a consideration of the manner in which cultural and technological changes may have placed human beings in a situation for which they could not yet be entirely biologically adapted. None of this contradicts notions developed in the present chapter if we consider synergistic relationships between gene expression and cultural evolution.

As was discussed in Chapter 5, suicide in many of its instances is not highly maladaptive. This is true in a strict biological sense insofar as suicide does not always extract reproductive potential from the population. This suggests that the social ecology of suicide has been constrained in some manner by natural selection. This manner is undoubtedly complex and may have involved the effects of selective pressures on suicide in several distinct but not contradictory ways.

First, human beings may have been structured before suicide began to occur such that the act would usually be conceived only where it had relatively little negative impact on the gene pool. This would be true to the extent that it was induced by stress and pathology in novel and harsh environments, where an individual might in any event be unlikely to reproduce. It would also be true if inherited human motivational structure and cognition were such that individuals would be unlikely to perform novel acts that operated against fitness. For example, because individuals may be cognizant of the fact that they behave toward the benefit of their children, they may be unlikely to engage in any novel acts which might harm them. If an individual were without children, this factor would not constrain him or her. It seems likely that the human psyche has long been structured such that individuals have some general conception of goals toward which they behave. There is probably some generalization of this to novel situations, which would prevent individuals from engaging in self-destructive acts when these acts would operate against their inclusive fitness. Accordingly, when suicide began to occur, it would already be unlikely that it would occur in biologically fit individuals.

Another, somewhat less plausible possibility is that when suicide originally began to occur in the human population because of technological changes and increased behavioral flexibility, it more frequently was a maladaptive act than it is today. Selection over generations may have subsequently limited its circumstances by acting upon any gene-expression factors associated with it. Some suicides occurring in novel circumstances today might be relatively maladaptive, but given several future generations of stable conditions, suicide in these circumstances may also become more limited in biological effect.

It would seem most plausible that these factors have operated in concert to determine the circumstances of suicide. In its earliest instances, suicide

may have been most likely where biological fitness was low because of gene-expression conditions already prevailing. Where during history suicide has occurred in relatively fit individuals, the selection factor it accordingly presented would decrease the probability that it would recur in such a maladaptive context. It also would seem likely that suicide did not suddenly begin to occur as a widespread human phenomenon, but rather that it gradually increased in frequency over evolutionary history. Its original occurrence on a limited scale might have been precipitated by technological and social changes and increased flexibility in the human behavioral repertoire. As changes in these directions increased over the course of human evolution, suicide frequency might have increased, and the diffusion through culture might have been facilitated by vicarious learning. Suicide would occur in novel manners and circumstances with new changes in technology, social structure, and the behavioral repertoire. However, it would be most likely to recur only in circumstances where it did not delete biological fitness.

Indeed, it could be argued that the fragmentary evidence on the cross-cultural, cross-species, and historical frequency of suicide suggests such a gradual increase in suicide frequency over human evolutionary development. As was discussed in Chapter 4, true suicide is uncommon in other species, although some similarities are evident in the sudden-death phenomenon and in the self-injurious behavior and despondency of primates in stressful situations. Suicide was reported to be least common among the least technologically advanced groups, such as Australian aborigines (Steinmetz, 1894; Westermarck, 1908). Among more advanced but nonindustrial societies, low to moderate rates are generally found, as should be evident from the discussion presented in Chapter 3. Some of the highest rates appear to be found in modern, technologically advanced nations such as those of Northern Europe, North America, and Japan.

The relationship of this to the gene-expression factors introduced at the beginning of this chapter is complex, but the notions are not irreconcilable. Any initial occurrence of suicide in a population would involve novel gene expression, no matter what the nature of environmental involvement in its determination, even if learning were a principal determinant. Suicide necessarily is a product of some gene-environment interaction, as is all behavior, and some artificialities are present in any attempt to partition genetic and environmental contributions to variance in behavioral attributes. Behavioral phenotypes do, however, vary in flexibility; some are relatively fixed regardless of the environment, whereas others are malleable. Also, differences in behavior among individuals may relate to either differences in experience or differences in alleles. However, any novel behavioral condition occurs within some genetic context.

Any occurrence of a novel behavioral phenotype is an occurrence of

novel gene expression. If this gene expression is life threatening, it should be affected differentially according to the amount of biological fitness it affects. Suicide occurring in individuals with residual reproductive potential would impose a selection factor against any genes associated with it. Suicide occurring in individuals past reproductive age or young but with low capacity to promote inclusive fitness would impose no such selection factor. If any particular genetic attributes facilitated suicide in individuals that were biologically fit, these attributes would be likely to remain low in frequency. If they facilitated suicide only when fitness was low, they could recur in the population. Suicide may be best construed as a synergy of culture and learning with genetics; natural selection may have influenced genetic components of this synergy.

A caveat is necessary here. It is quite unlikely that differences in genetics alone are responsible for individual differences in suicidal tendencies. Furthermore, it is well established that learning and cognition play major roles in the etiology of suicide. I am speaking of genetic involvement in a much weaker sense than some readers may have assumed. That sense involves the gene expression that is brought on by various environmental events, such as stress, senescence, and coping failure. I have emphasized the relationship of suicide to natural selection because this dimension has been ignored in previous analyses of the subject, and because it may explain the social ecology of the act more clearly than do any of the more proximate determinants of the act.

9

Altruism and Suicide

The sociobiologists have described a number of conditions in which individuals may behave toward the benefit of others at their own expense, generally referring to such behavior as *altruism*. They have primarily described manners in which pressures of natural selection would favor self-sacrificing behavior that is beneficial to others. I would like now to examine whether any form of altruism might be involved in the determination of human suicide. This should also complete the attempt to account for the social ecology of suicide.

Durkheim (1951), in his pioneering nineteenth-century sociological work on suicide, stated that some cases of this behavior could be classified as altruistic. Durkheim's altruistic suicide occurred in individuals who felt very much a part of a group and sacrificed themselves for the good of that group or society in general. Durkheim did not, of course, make any attempt to relate this to pressures of natural selection, nor did he have available to him the perspective of modern sociobiological work on altruism. However, implicit in his discussions was the notion that some suicides are motivated by their beneficial effects on others.

I have made frequent reference to indirect manners in which individuals can propagate their genes or promote their fitness, as opposed to direct manners involving survival and reproductive activity. In discussing altruism I would like to spell out more precisely how this can occur. There are really two manners in which indirect modes of gene propagation may relate to suicide. First, suicide that benefits others sharing the individual's genes may be motivated by actual improvements it produces in inclusive fitness. Second, the ability to act toward the benefit of others sharing one's genes, through normal non-life-threatening behavior, may provide some immunity against suicide.

Selection Processes and Altruism

Darwin, writing in *On the Origin of Species*, introduced the concept of group selection to account for the evolution of sterile castes in social insects. The notion that differential survival of semi-isolated demes, groups, or subpopulations could affect gene frequency was extended by Haldane (1932), Kalela (1954, 1957), and Wright (1945). But it was Wynne-Edwards (1962) who brought the idea of group selection to wide attention by suggesting that it might explain a large variety of social behavior patterns. Wynne-Edwards argued that behavioral traits may have evolved through selection among reproductively isolated groups with different gene frequencies within a species, in that such groups differentially survive and reproduce. A gene predisposing toward altruistic behavior might diffuse through the population over generations by group selection despite the fact that its expression in an individual decreases his changes of survival. This diffusion would occur insofar as this expression benefits other group members in whom the gene is carried but not expressed. Group selection may occur on a number of levels, from differential survival of species (see Stanley, 1975) to differential survival of small, reproductively isolated subpopulations.

A distinct but related form of selection was expounded by Hamilton (1964, 1970, 1971). Maynard Smith (1964) termed this form *kin selection*. Kin selection occurs when individuals propagate their genes by behaving toward the benefit of close relatives who share a large portion of these genes by common descent. An individual may indirectly propagate his or her genes by behaving to enhance the fitness of close relatives, even if the behavior acts at his or her own expense. Thus, genes favoring altruism toward kin may diffuse through the population over generations because costs to the fitness of the genes in the altruistic individual are outweighed by benefits to the fitness of the same genes as they exist in the recipients of the altruism.

The theory of altruism has been extended further with the concept of reciprocal altruism, developed especially by Trivers (1971). The most commonly cited example (e.g., see E. O. Wilson, 1975) is that of a drowning man who might be saved by an unrelated individual. If the man has a 50:50 chance of drowning, and a rescuer a 1:20 chance of drowning in attempting to save him, the cost to the rescuer may be outweighed by the possibility of future reciprocation. If the situation is reversed at some future point and the altruism returned, both parties gain in that each has traded a 50:50 chance of drowning for about a 1:10 chance. Trivers has argued that human behavior abounds with examples of reciprocal altruism. The mechanisms by which genes favoring such altruism would diffuse through the population are unclear. Boorman and Levitt (1973a) have indicated that the initial diffusion of such genes would be quite difficult, but that once they had reached a

critical frequency they would quickly spread through the population. It is conceivable that kin or group selection or genetic drift could bring such genes up to the critical frequency (E. O. Wilson, 1975).

Gene Sharing among Individuals

An important aspect of the theory of altruism rests upon the extent of gene sharing among individuals in the population. An individual's "inclusive fitness" takes into account the fact that his genes are represented in others. The most commonly cited model of gene sharing is that developed by Galton (1889), Hamilton (1964), and Wright (1922). Their "coefficients of relationship" or "r-values" consider gene sharing by common descent or kinship based on the fate of genetic complements in meiosis and fertilization. According to these coefficients, an individual inherits about one-half of the genes of each of his or her parents, and on the average shares one-half of the genes of each of his or her siblings, one-quarter with an uncle or half-sibling, and one-eighth with a cousin. Considering only genes shared by common descent, then, one approaches a point of zero gene sharing rapidly in considering individuals progressively less related in a familial sense.

However, these calculations of gene sharing are based on gene flow in only the most proximate generations and assume an infinite population size with panmictic breeding. Considering the totality of generations in a species's history increases immensely the complexity of interrelationships among individuals. Individuals also may share genes by kind, given that a limited number of alternative alleles for any particular gene locus may be found in the population. Thus, for example, individuals may share alleles favoring particular eye colors, blood types, or skin colors despite the fact that they may not be related in a familial sense. The extent of gene sharing by kind in the population is a matter of debate and is exceeding difficult to determine. King and Wilson (1975a) have reviewed data on gene sharing within the human species and between humans and chimpanzees. They estimate that the overlap between human and chimpanzee DNA and amino acid sequences is 99% and that variance within either species is considerably less than the between species variance. Washburn (1978) has used this point to argue that extensive gene sharing among human individuals may be conducive to much greater altruism than has been assumed by sociobiologists, but this oversimplifies the situation. Many genes may be relatively fixed in the population and consequently may not contribute to interindividual variance. Also, as King and Wilson (1975b) have argued, there may be differences in the variability of structural and regulatory genes. Sharing by kind of genes that are relatively fixed in the population may not be of much interest for the

study of altruism. However, sharing by kind of genes that occur with a relatively small number of competing alleles in the population may be quite important for the theory of altruism. This latter form of gene sharing is probably derived from complex interrelationships of individuals that occur because populations are not infinite in size, breeding is never truly panmictic, and thus some inbreeding is always present.

Accordingly, it is likely that the extent of gene sharing is quite complex. There has been a tendency for some researchers and theorists to insert the Hamilton-Wright coefficients into a calculus of the costs and benefits of altruism. This is instructive and may hold some validity in consideration of diffusion of novel genes through kin selection. But the Hamilton-Wright coefficients provide a ratio scale when only an ordinal scale is justified. We cannot define a zero point of gene sharing, and depending upon the structure of the population, there may be artificialities in treating a lack of familial kinship (considering proximate generations) as meaning a lack of common interest.

Considering genes shared by kind as well as by common descent, there should be a progression away from gene sharing between individuals with further removal from one another spatially, temporally, ecologically, racially, phylogenetically, and so on. Individuals from the same kinship group share more genes than those from the same tribe, who in turn may share more genes than those from the same race or subspecies. Those from the same race or subspecies are likely to share more genes than any two members of the same species, whereas members of different species may share genes in degrees dependent upon the species's phylogenetic distance. There are thus discontinuities in the degree of gene sharing that depend upon the levels of organization within the species and upon various reproductive barriers. It would seem most important for the theory of altruism that we consider the extent of gene sharing among natural aggregations of individuals who are likely to interact in either selfish or altruistic manners. The complexities of gene sharing among members of natural human aggregations are illustrated by the calculations of genealogical relationships within Yąnomanö villages by Chagnon (1979), who found that individuals within these villages were often related through several common ancestors and intermarriages even considering only more recent generations.

Relative Strengths of Different Orders of Selection

Simple extent of gene sharing cannot be used as a precise index of commonality of interest and tendency toward altruism. The evolution of altruism requires modes of selection, as well as simple gene sharing, that would bring

about tendencies of individuals to behave toward the benefit of some grouping or some other individual. These modes of selection would have to compete with pressures of individual selection. Despite the plausibility of processes such as kin and group selection, the most straightforward and profitable manner in which an individual may promote his genes is through behavior promoting his own survival and reproduction.

Wynne-Edwards' (1962) idea that group selection has played a central role in the evolution of social behavior has been subjected to a considerable amount of criticism. The group-selection controversy has been fought principally on theoretical rather than empirical grounds. Some theorists (e.g., Wiens, 1971; Williams, 1966), have argued that many of the behavior patterns attributed to group selection by Wynne-Edwards can be explained otherwise. Others (e.g., Boorman & Levitt, 1973b; Gilpin, 1975; Levin & Kilmer, 1974; Levins, 1970) have addressed the question of group selection through a variety of mathematical and computer models. Although all of the models have shown that group selection is possible, it has generally been argued that the population structure required for group selection to operate is infrequent in nature. The models indicate that group selection could occur only within a highly restricted set of population parameter values. This has led many researchers (e.g., Dawkins, 1976; Maynard Smith, 1976; Williams, 1966) to conclude that group selection is a relatively insignificant force in evolution, and that individual selection will override group selection in almost all cases where the two are in competition.

Group selection is not without its proponents, however. D. S. Wilson (1975, 1977) has argued that group selection of a sort may occur in a population which, although breeding at random, is divided for some part of the life cycle into "trait groups." These trait groups are comprised of individuals that interact with respect to the trait under consideration. If the between-trait-group genetic variance is greater than random, altruistic traits may increase in frequency over generations. Wilson also argues that group selection does not require extinction of some groups, but rather the differential contribution of groups to a common gene pool. Bell (1978) has supported Wilson's concept of group selection, and has argued that a rigid distinction between individual and group selection would be artificial. Wade (1978) has also presented some compelling arguments in favor of group selection. Wade points out that most of the mathematical models of group selection have examined it when it is in competition with individual selection in the determination of some trait. He argues that the assumption that these selection processes work in opposite directions may not always be valid. Given situations in which the two processes act in a similar direction or where group selection is orthogonal to individual selection, group selection may have a major influence over the evolution of behavior.

The importance of kin selection is not the subject of as much debate as is that of group selection, and interest in W. D. Hamilton's models has steadily mounted (E. O. Wilson, 1975). The concept of inclusive fitness has proven to be of considerable value in the study of animal behavior in explaining altruism among close relatives, the best example of which is parenting behavior. The notion has also been extended to explain interactions among close relatives in humans (e.g., Barash, 1977; Chagnon, 1979). Some modifications to Hamilton's models have been suggested (e.g., Charlesworth, 1978; Charnov, 1977; Michod & Abugov, 1980; Orlove, 1975; Wade, 1980), but the basic notion that evolution may favor altruism directed toward close relatives has not been seriously challenged. Indeed, kin selection and inclusive fitness have provided much of the basis of modern sociobiological theory.

In summary, there is some agreement that in the general case, self-serving behavior would propagate individuals' genes more readily than would kin-serving behavior, which in turn might propagate their genes more readily than behavior serving some larger group. However, a variety of circumstances have been suggested by researchers and theorists under which selection processes of a higher order than individual selection might strongly influence behavior. The debate has primarily concerned the parameter values necessary for the influence of these higher order processes and the extent to which such necessary parameter values have occurred in nature.

Kin Selection and Human Suicide

Implicit in much of the discussion of selection processes and altruism is the idea that an individual sacrifices his or her personal fitness and welfare in aiding other individuals. Such a sacrifice may be limited to an expenditure of time and energy for another's benefit, but it may also entail some loss or risk of loss of individual welfare. In its most extreme case, this entails something akin to suicide, in that suicide may be viewed as the most complete self-induced loss of personal welfare. The question is whether we can legitimately invoke altruism and the selection processes conducive to it in the determination of human suicide. In its clearest case, this would require that suicide or some distinct subset of suicides generally produced a benefit to surviving others.

Kin selection might have been involved in the evolutionary development and current incidence of human suicide insofar as suicide occurs, or occurred during evolutionary history, where it benefited surviving relatives. This involvement might not be so much a direct development of "prosuicidal genes" through kin selection, but rather would more likely act in an indirect manner.

Given that selection has probably favored the tendency for individuals to behave toward the benefit of kin, individuals may encounter situations in which they cognitively envision that the best way to aid their kin and promote their inclusive fitness would be through suicide. This might especially be true if the individual were a burden on relatives and if his or her death ended this burden.

There is certainly some empirical support for the idea that benefits accruing to kin are among the determinants of some suicides. A notable example is found among Eskimo cultures, where it is explicitly recognized that benefit to kin and tribe are involved in suicide among the elderly and infirm. Weyer (1932) says

> The Eskimos of Baffin Island have great respect for the aged and treat them well. But when a woman becomes so old that she is a burden, she may calmly resign herself to death, allowing herself to be walled into a snowhut and left to die. She thinks it is better; the tribe agrees [p. 138]."

Leighton and Hughes (1955) generally confirm this notion of an involvement of kin benefit in suicide in a number of Eskimo tribes, noting that the usual reasons for giving up one's life are sickness, suffering, and the feeling of uselessness. Similar determinants and antecedents are involved in many suicides from a variety of cultures; in few others, however, is it so clearly recognized that benefit to kin is a principal reason for the act.

There are also clear cases from more developed cultures where suicide is linked to some benefit accruing to surviving kin. Dublin (1963) has cited the possible motivation of suicide by large potential life insurance payments to the individual's surviving family, although he contends that such cases are not common. An example of a suicide note that suggests that the suicide will benefit kin is found in an article by Shneidman (1976c), as is clear from this excerpt: "I only hope that I do a good job of it. Then your troubles will be over with. I know this is what you have been hoping for for a long time. I'm not crazy, I just love you too much!!! [p. 270]." Another case is a suicide cited by Choron (1972) of an outstanding German political scientist and economist who was prevented from providing for his family by illness and his political past:

> My dear Kolb, I have started to write at least ten times to my admirable wife and to my children but I couldn't bring it off . . . my headaches and distress grow stronger every day, in addition, the horrible weather . . . and then the future—without income from my writings I would have to use up my wife's 'capital' (since I have none) and which is not even enough to take care of her and the children. I'm close to despair. God have pity on my family. Whatever you and other friends will do for them, God will reward you [p. 57]."

One other argument in favor of the involvement of kin selection in some suicides is that certain family patterns, such as broken homes, economic difficulties, and the consistent receipt of blame for family problems, commonly occur in the backgrounds of suicidal individuals (Jacobs, 1971; Richman, 1971).

A strong argument, however, can be made against the involvement of altruism directed toward kin in the majority of suicides. Although old age, infirmity, and coping difficulties, which are major antecedents of suicide on a worldwide basis, would generally make individuals burdensome to relatives, isolation from kin is also very often a key factor (see Chapter 5). It is difficult to conceive of how the suicide of an individual that is isolated from kin could act toward their benefit. Reduced contact with kin would presumably mean that the act would have relatively little impact upon them. Also, in many cases suicide is a source of considerable grief to surviving relatives (McCulloch & Philip, 1972). Such grief is indicative of a negative impact on kin, who may perceive of the suicide as a loss to their inclusive fitness (whether or not there is truly any loss of reproductive potential). It is difficult to reconcile the fact that suicide often has no impact or an apparently negative impact on kin with the notion that the death is for their benefit.

Indeed, the fact that very high rates of suicide are found among those without children or with reduced contact with kin suggests that something that is in a sense opposite to kin selection, but yet related to inclusive fitness, is involved in many cases of suicide. That is the fact that life may lose purpose if there is reduced opportunity to behave toward the benefit of genetically related individuals. In many cases it seems that an inability to behave toward the benefit of kin, rather than an anticipated benefit toward kin, is implicated in suicide, although both could be involved in some cases.

Group Benefit and Human Suicide

This brings us to the more difficult question of group benefit derived from suicide. It is conceivable that individuals with reduced reproductive capacity due to aging or coping failure are in a sense burdensome on the population to which they belong. They consume resources without returning any benefit to the population, insofar as their productivity toward the benefit of the society is usually reduced by their age or severe coping difficulties. In a sense it is not optimal for a population to carry individuals that do not contribute to the gene pool directly through reproductive and nurturing behavior or indirectly through productive behavior benefiting the population. The arguments I have developed on the social ecology of suicide clearly suggest that individuals committing suicide are among those with reduced reproductive and

productive capacities. At some point in human evolutionary history, subpopulations losing burdensome members through suicide may have fared better than subpopulations retaining such members. This would occur in that the consumption of resources by those with coping difficulties would tax the subpopulation without contributing to its short- or long-term reproductive benefit, whereas suicide would relieve this burden.

It seems clear that coping difficulties and low reproductive and productive potential do relate strongly to suicide, as was argued especially in Chapter 5. It might also be inferred that such individuals could tax the resources of the social group to which they belong. There is also a substantial amount of evidence indicating that emotions of "guilt" and "shame," which imply a consciousness of doing harm to others, are involved in many suicides in diverse cultures. In psychodynamic theory, guilt of transgression, shame, inadequacy, and worthlessness are often cited as antecedents of suicidal motivation (Perlin & Schmidt, 1975). Breed (1972) also cites shame as one of his five components of a basic suicide syndrome. Such shame involves failure in a role to which a person has been highly committed and where the failure has been publicly recognized. Shame is also a common apparent motive for suicide among the African tribes discussed in Bohannan's (1960) volume, while guilt and the shattering of self-image are also frequently cited by Meer (1976) in the discussion of South African suicides. Shame also figured in cases in the Trobriand Islands cited by Malinowski (1926).

A critical role of the degree of social integration in suicide has been cited by several researchers, especially the sociologists. Durkheim (1951) was particularly responsible for the advancement of this notion. Henry and Short (1954) spoke of the "strength of the relational system," implying that people deeply and intensely involved with others are low suicide risks, whereas those isolated from meaningful relationships with their fellow humans are high suicide risks. Those without such "meaningful relationships" are presumably those less capable of working toward the common good. Gibbs (1957) further advanced the notion of social integration and suicide. This notion is highly consistent with the idea of group benefit and suicide, in that those that can actively contribute to the benefit of the group are least prone to suicide.

Accordingly, it seems conceivable that some group benefit is derived from at least a proportion of suicides. The more difficult question is whether this benefit has been instrumental in the development of suicide as a recurring phenomenon in the human population. It is difficult to assess whether group selection has been involved, but some speculation and theorization seems warranted on the basis of the social pattern of suicides. The arguments of D. S. Wilson (1975, 1977) and Wade (1978) have revitalized the plausibility of group selection having played a role in the evolution of behavior. There is

some consensus that where groups are small and between-group genetic variance is greater than within-group genetic variance, group selection remains plausible (cf. Bell, 1978; Maynard Smith, 1976; Wade, 1978; D. S. Wilson, 1977; E. O. Wilson, 1975). The question is whether sufficient conditions have occurred in human evolution for group selection to have played an important role.

Most theorization about group selection has dealt with nonhuman animals. The blind extension of principles derived from animal studies to humans may not do justice to our species, which has many unique attributes. During most of human history there has been a large amount of interdependency among individuals that might be favorable to the operation of several modes of selection conducive to altruism. There has been a degree of organization at a variety of different group levels that may not characterize other species. The hunting and gathering bands that existed during much of human history are an important example, especially since such groups were usually fairly small. Larger and more complex group organizations have characterized more modern history, including tribes, city-states, countries, and so on. There have also been groups founded on common interests, such as clubs, unions, and pressure groups. Throughout human history there appears to have been an extraordinary degree of intraspecific aggression organized at a group level. Wars have occurred between groupings of various sizes, and an individual's fate may often have been dependent upon the fate of his or her group. While complete annihilation of one group by another may have been rare, some differential reproductive success of groupings would undoubtedly accrue from success or failure in intragroup competition.

Individual selection and reciprocal altruism could play some role in this, in that individuals may perceive their own advancement as being contingent upon their group's advancement. Furthermore, the role of human culture in the development of altruistic traits may be critical and has often been ignored in discussions of human altruism. Through the organized application of sanctions to those that serve themselves at the expense of the group, a culture may over generations select against selfishness and in favor of altruism. Human cultures throughout known history have dealt punishment and reward, respectively, to those behaving selfishly and altruistically. In addition to shaping the behavior of individuals through operant conditioning, such punishment and reward produces some differential reproductive success. Those that behave toward the benefit of the group may be rewarded by favors that enhance their reproductive fitness. More commonly perhaps, those transgressing the society's rules meet death or incarceration which may eliminate or reduce reproductive prospects. Thus, human group organizations may produce selective pressures which operate over generations in favor of the development of altruistic traits.

This would mean, in effect, that cultural sanctions and group organization should be added to the list of selective pressures favoring altruism in humans. The role of such selection in human suicide is another matter. Some role of cultural pressures in institutional forms of suicide (see Farberow, 1972), such as suttee or hara-kiri, is quite plausible. However, the imposition of sanctions might not generally be involved in personal suicides occurring in times of stress, aging, or social isolation, in that it would be difficult for a culture to reward a person after his death. A culture could reward an individual's progeny for his or her suicide if this conferred honor on or removed shame from his or her name, directly affecting the fitness of surviving kin. A culture could also in subtle manners make suggestions to burdensome individuals that their suicides are desirable, although this might rely upon individuals' suggestibility rather than their personal interests. It is also conceivable that the pressures favoring altruism among humans have been such that individuals generalize a tendency to behave altruistically to novel situations, and perceiving of themselves as burdensome or of low value in society and seeing no other purpose to life, conceive of suicide as the only act that advances their interests.

Aging, Reproductive Status, and Altruism

This brings us to a consideration of the relationship of altruism to the individual's coping and reproductive status. As was discussed above, many of the models of group and kin selection have examined these with the assumption that they operate in competition with individual selection. Wade (1978) argued that group selection might have some fairly powerful influences over behavioral traits when it operated in the same direction or orthogonal to individual selection. I would like to extend this by considering the fact that in many situations, individual selection may become inoperable, which would leave only higher orders of selection to influence behavior.

Indeed, the thrust of Chapters 5 and 8 has been that individual selection no longer operates where an individual passes reproductive ages or loses the capacity to reproduce through coping difficulties and competition in younger ages. The loss of a capacity to reproduce entails that individual selection should no longer have any influence over the individual's genes. There is good reason to assert that, in general, individual selection is more powerful than kin selection, which in turn is more powerful than selection among various groups. But what happens if individual selection is rendered impotent, as it is by the passing of reproductive age or by the loss of the capacity to reproduce through various coping failures?

Many individuals pass reproductive age but retain an opportunity to enhance the fitness of offspring or other potentially reproducing kin. Perhaps

the major selective pressure that would have operated to shape behavioral orientations in such individuals would be kin selection, since individual selection could not operate on gene expression in such a situation. Similarly, the behavioral orientation of younger but nonreproducing individuals with contact with kin would presumably have been strongly influenced by kin selection.

In the shaping by natural selection of gene expression in individuals without an opportunity to reproduce and without favorable contact with potentially reproducing kin, both individual selection and kin selection have been rendered impotent. Hence the only selective pressures that may have influenced behavioral orientation for such individuals may be group-selection pressures. The only opportunity that individuals without capacities to reproduce and work toward the benefit of kin have to propagate their genes may lie in behavior promoting the welfare of their group or subpopulation. In some circumstances group selection could operate unimpeded by individual and kin selection.

Consideration of this critical dimension has been sorely lacking in discussions of group selection. As was mentioned, most of the models of group selection have pitted it against individual selection, and have accordingly concluded that it is a relatively insignificant force in evolution. But the power of individual selection breaks down at some point in the life span of most individuals as they lose the capacity to engage directly in reproductive behavior. Kin selection similarly may break down if the capacity to aid the reproduction of relatives breaks down. What may be left are individuals whose behavior may only play a role in some sort of group benefit. An individual's optimal strategy for propagating his or her genes, when he or she cannot reproduce nor work toward the benefit of reproducing kin, may lie in working toward the benefit of some larger cultural grouping. The small hunting and gathering groupings that characterized most of human history may have shared a great number of any constituent individual's genes; indeed, the totality of an individual's genes excepting any specific mutations he or she may carry should be represented in the population, although due to migration this may not always hold for more proximate groupings. In summary, group-directed behavior may be facilitated by failure in direct reproduction and kin-promoting behavior.

Let us consider now what happens if coping difficulties are so severe that individuals are unable to behave productively toward the benefit of their group, subpopulation, or even species, as well as having lost the capacity to reproduce and work toward the benefit of kin. Such individuals may then be dependent upon others for resources, such as food, clothing, and living space, which maintain their existence. This would mean consumption of common resources without benefit to the common fitness, which would make such individuals burdensome or part of the genetic load of their

population. It is in such situations that death might be predicted on the basis of selective pressures (see also Chapter 8). It is also fair to say that this is when many suicides occur (see Chapter 5). The individual no longer has reason to live, and not uncommonly this is verbally expressed in that way (see Beck, Kovacs, & Weissman, 1975; Choron, 1972; Neuringer, 1976; Shneidman, 1976c). Indeed, if such an individual is burdensome, he or she may have reason to die as the optimal manner of promoting the subpopulation's welfare.

If kin and group benefit are to be invoked as determinants of suicide, the question of why suicide occurs rather than homicide could be raised. Might it not be more to the point for selective pressures to favor murder of the burdensome individual by the recipients of the benefit of the death rather than for suicide to occur? This is indeed a valid question, and would in part depend on the relative strengths of kin-group solicitude acting on burdensome individuals and individual interests acting on the recipients of the benefit. One consideration is that murder is a discouraged and punishable act in most cultures, and that its encouragement in one context might lead to its occurrence in other, less socially desirable contexts. Another consideration is the relationship between murder rate and suicide rate; some evidence suggests these are inversely related in frequency across cultures, although both can increase in times of general social disorder (see Henry & Short, 1954). Furthermore, we must consider that some proportion of suicides may indeed be disguised murders, while in some cases other individuals may aid and abet an individual's suicide. Finally, if an individual's death is for the benefit of a large social grouping as a whole, with no specific individuals being especial recipients of the benefit, selective pressures may more readily act on the burdensome individual's behavior than on the collective behavior of the group.

Modern Conditions and Exceptional or Aberrant Cases

Suicide may not always occur where the capacity to promote inclusive fitness has become very low, as was discussed in other chapters. In some proportion of cases the individual may have some residual reproductive capacity or may be experiencing coping difficulties that are potentially transitory or which exist only relative to expectancies of achievement. As was discussed in Chapter 7, some such cases may derive from pathological conditions, novel environments, or aberrant learning. It is also conceivable that factors of altruism could induce suicide in individuals retaining some direct or indirect reproductive potential. This would occur where the benefit to be derived by kin or subpopulation from the suicide was sufficient to outweigh the loss of direct reproductive potential.

Another point to consider is that the modern conditions in which suicide is expressed may differ somewhat from the conditions in evolutionary history which favored or tolerated its development. This may especially be important to factors of kin and group selection in that the modern social structure differs in a number of respects from that prevailing during human evolution. In developed countries the extended family has broken down and the nuclear family unit also may be threatened. We no longer live in small groups that are relatively stable through the life span; rather, urbanized human beings are in contact with a genetically diverse population, they are geographically mobile, their interactions with other individuals may be impermanent, and the units of organization in society may be larger. This presents a socially novel environment, which may mean that inherited predispositions are out of ecological context, and thus not necessarily expressed in an adaptive manner (see Chapters 7 and 12).

One possibility is that the frequency of suicide may have been increased by this transition in social structure. This is consistent with the sociologists' notions that suicide is increased in a society that is not socially integrated (Durkheim, 1951; Gibbs, 1957; Gibbs & Martin, 1964; Henry & Short, 1954). More individuals would be found in novel social situations, social isolation, and where the ability to promote their inclusive fitness is low, which would be conducive to suicide by means I have explained.

The other aspect of this is that the factors conducive to predispositions favoring suicide may now be expressed in circumstances very much unlike those in which they were selected. For example, kin solicitude may have played a more important role in the origin of suicide than is apparent from the current social ecology of the act. Formerly, individuals most frequently lived in hunting-gathering groups or agricultural villages composed of fairly small populations of individuals related by a variety of kinship ties. In such a situation, kin and group favoring behavior may have been less distinguishable than they are currently, and suicidal altruism among the burdensome may have been supported by fairly strong selection factors. Today, individuals more commonly are surrounded by genetically less related individuals. However, rejection, dependency on others, shame, guilt, or a feeling of burdensomeness might be interpreted by the modern individual as the occasion for suicide because of predispositions originally shaped when individuals existed in small, genetically related groupings. Similarly, modern individuals may view their coping difficulties as greater than they are in fact because current-day social situations may superficially resemble those in which suicidal predispositions were selected. Thus, in some exceptional modern cases, suicide may involve a loss of biological fitness. In these cases a behavioral system may be "misfiring" because it is expressed in conditions resembling but not truly like those in which it was selected.

Conclusions

An assessment of the role of altruism in human suicide requires improvements in the theory of human altruism. The selection processes proposed to explain altruism by the sociobiologists were developed primarily to explain the behavior of nonhuman animals and without a consideration of some relevant and unique human attributes. The role of human culture and its ability to select for altruistic traits have not previously been given adequate consideration. Also, the relative strengths of selection processes that have shaped gene expression in those experiencing changes in reproductive and coping status have not been adequately considered. These factors, taken with conventional models of group and kin selection, do suggest that altruism may have played a role in the evolution of the human capacity to commit suicide. The social ecology of the act in many cases is such that it reduces the consumption of resources by those that have little remaining reproductive and productive potential. However, a full assessment of the role of higher-order selective processes and altruism in suicide requires an improvement in the understanding of human evolution.

It should be emphasized again that it may be quite unlikely that specific genes are *directly* conducive to the occurrence of suicide. We must accordingly modify the arguments of the sociobiologists to adapt them to the human situation. It is unlikely that some specific "altruist gene" favoring suicide arose originally as a mutation, then gradually increased in frequency through the actions of kin-group selection. Rather, as explained in previous chapters, particular gene expression conditions arose in novel environments as the human behavioral repertoire expanded (see especially Chapter 6). The recurrence of suicide would have been facilitated by observational learning and the likelihood that coping difficulties induce conditions in which gene expression need not promote the individual's survival. It may have been after these developments that group and kin selection had some major effect on the frequency of behavioral predispositions and gene-expression factors modulating the probability of suicide. Also, because individuals may have long been structured such that they act toward their inclusive fitness, which occasionally entails action favoring others at the individual's expense, novel acts of suicide might have been conceived for altruistic motives. A synergy of factors is necessarily involved in any case, and it is conceivable that selective pressures conducive to altruism have played a major but ancillary role in this synergy.

10

Suicide, Physiology, and Behavioral Predispositions

At several points I have made allusions to a potential role of inherited motivational dimensions in suicidal behavior. In essence, I have suggested that the human motivational substrate may be variable, favoring life-preserving behavior under most but not all conditions. This variation in life-preserving behavior is indicated by the breakdown of self-adapting behavior in conditions of "stress", "helplessness," or "hopelessness," and the orientation of behavior toward death in many individuals in such circumstances. This corresponds to pressures of natural selection, which theoretically should only favor life-preserving behavior in individuals with the potential ability to promote the continued existence of their genes in future generations. There are strong selective pressures in favor of life-preserving behavior and against self-damaging behavior in individuals with an ability to promote their inclusive fitness; where this ability is absent there may be no selective pressures favoring self-preservation or against self-destruction.

An additional perspective can be added to this discussion. To some extent, current knowledge of physiological and behavioral processes allows us to identify specific mechanisms which may subserve self-preserving and even self-damaging behavior. The disciplines of neuropsychology and behavioral endocrinology have been advancing at an exponential rate during the last few decades. These have provided a wealth of new knowledge about the physiology of motivation, which in turn may ultimately allow identification of some innate mechanisms subserving the general orientation of behavior. Although much remains to be discovered or clarified and much of current knowledge is tentative, increasingly we are able to decipher consistencies in behavioral processes by investigating physiological mechanisms underlying these processes.

Not only does the identification of physiological mechanisms facilitate an understanding of the consistencies of behavior, it may also address controversies about the role of learning, genetic differences, or gene expression in behavior. When a physiological mechanism is stereotyped across individuals and does not involve associative processes or learning, we might assume that it is part of the individual's innate constitution. For example, if elevation of levels of a particular hormone consistently causes the onset of a particular behavioral pattern in all or most members of a species, attributions of that onset to learning become less credible. Variations in the hormone level in different environments, if they follow a consistent pattern across individuals, may more parsimoniously be attributed to environmentally determined gene expression than to learning. There may also be individual differences in the functioning of this hypothetical hormone that are subserved by genetic differences.

The Euphoria–Dysphoria Dimension

It is increasingly apparent that the continuum in subjective states of "elation" or "joy" to "sadness" or "depression" is not simply a function of cognition and learning. Rather, there appear to be stereotyped neurochemical processes that mediate this continuum and which bear a complex relationship to cognitive states and demands upon the individual. The evidence comes primarily from pharmacologic studies and investigations of neurochemical processes underlying the action of pharmacologic agents. Supportative evidence has also come from electrophysiological studies, especially those carried out in conjunction with pharmacologic investigations.

A great deal of attention has focused upon the role of certain neurotransmitter substances of the central nervous system, especially the catecholamines, norepinephrine and dopamine, and the indoleamine, serotonin. These substances are found in certain synapses between neurons in the brain; they are believed to be released by electrical activity of the presynaptic neuron and to affect the probability of impulses in the postsynaptic neuron. Tracts and nuclei involving norepinephrine, dopamine, and serotonin are found primarily in the brain stem, diencephalon, parts of the limbic system, and some projections to other parts of the brain (see, for example, Cooper, Bloom, & Roth, 1974).

Pharmacology of Affect

The observation that certain drugs that alter affective states in humans also have profound effects upon these neurochemical systems led to hypotheses that endogenous catecholamines and serotonin mediate affective states (see

reviews by Barchas, Akil, Elliott, Holman, and Watson, 1978; Bunney & Fawcett, 1968; Murphy, Campbell, & Costa, 1978; Schildkraut, 1978). Drugs acting as catecholamine stimulants, such as amphetamine or cocaine, can induce subjective states of elation and well-being. Two classes of drugs that are known to be quite effective in relieving protracted periods of depression are the tricyclics and the monoamine oxidase (MAO) inhibitors. Tricyclics, such as imiprimine, are assumed to interfere with the reuptake of norepinephrine from the synapse by the presynaptic neuron after it has fired, thus increasing levels of the transmitter in the synapses. Tricyclics are known to produce a substantial elevation of mood in many chronically depressed individuals, but may not affect normal individuals. MAO inhibitors, such as iproniazid, act upon the enzyme MAO, which is believed to break down the catecholamines and serotonin in their respective synapses. The administration of MAO inhibitors thus increases levels of these brain amines in the synapses, which may explain its antidepressant effect. Other evidence indicating that catecholamines and serotonin may be involved in affect comes from studies of drugs reducing the action of these transmitters. The drug reserpine is believed to deplete levels of catecholamines and serotonin in the brain (see Goodwin & Bunney, 1971). It has also long been known to induce severe depression in some proportion of individuals taking it. Reserpine is believed to impair the processes by which brain monoamines are stored in the synaptic vesicles of the presynaptic neuron and to allow the monoamines instead to be degraded.

It has accordingly been hypothesized that those suffering from monopolar depression have some deficit in brain catecholamines and/or serotonin. Bipolar depression, involving oscillation between manic and depressive states, is believed to involve a somewhat different underlying physiology, possibly a corresponding oscillation in monoamine levels in the synapse (see Bunney, 1978; Katz & Hirschfeld, 1978). The drug lithium carbonate is believed by many to be more effective for bipolar depression than tricyclics or MAO inhibitors. This drug is believed to exert a stabilizing influence over monoamine levels.

Data from Biochemical Assays

For both monopolar and bipolar depression, the involvement of low monoamine neurotransmitter levels has also been studied by measurements of the metabolites of these transmitters. It is not possible to measure directly the levels of neurotransmitters in living individuals with current technology. However, by-products of the breakdown of monoamines are available in urine, blood serum, and the cerebrospinal fluid, and should reflect to some extent the turnover rates of these transmitters. For example, 3-methoxy-4-hydroxyphenyl glycol (MHPG) is considered to be a major metabolite of

norepinephrine and is measurable in urine and cerebrospinal fluid. Schildkraut (1978) has reviewed several studies of levels of MHPG and other catecholamine metabolites in humans with affective disorders. An earlier, more critical review is that of Shopsin, Wilk, Sathanathan, Gershon, and Davis (1974). Although urinary levels of MHPG may in part derive from peripheral sympathetic nervous system activity, greater than 50% may come from activity in the brain. In longitudinal studies of individuals with bipolar depression, urinary MHPG has been found to be high during periods of mania and low during depressive periods. This may result in part from motor activity changes, although it suggests that low levels of endogenous norepinephrine activity characterize depression. There are also some data indicating that MHPG in cerebrospinal fluid is lower in depressed patients than normals, although other studies have not confirmed this difference, while several physiological confounds reduce the value of cerebrospinal fluid data on MHPG. Schildkraut (1978) also reviewed data on the relative concentrations of homovanillic acid (HVA), a metabolite of dopamine, in depressed and control patients. Many, but not all, studies of HVA levels in cerebrospinal fluid find lower levels in depressed patients. In summary, the assay data provide some support for a role of catecholamines in depression, especially in the alternations between manic and depressive states in bipolar depression, but the data are as yet by no means conclusive.

The pharmacologic evidence for an involvement of catecholamines in depression is also not entirely consistent. Attempts to treat depression by giving precursors of catecholamines, such as tyrosine or L-dopa, have not generally been successful (Mendels, Stinnett, Burns, & Frazer, 1975; Shopsin, Friedman, & Gershon, 1974). This may not conclusively refute the catecholamine hypothesis, however, in that drugs like L-dopa may not actually affect norepinephrine levels and may reduce serotonin levels.

The assay data on serotonin have generally supported a role of this transmitter in depression, with evidence being more conclusive than that obtained for the catecholamines. Murphy *et al.* (1978) have reviewed these data. It is found quite consistently that 5-hydroxyindoleacetic acid (5-HIAA), the major metabolite of serotonin, is reduced by an average of about 30% in the cerebrospinal fluid of depressed individuals. There are also studies (e.g., Mendels *et al.*, 1975) showing that ingestion of L-tryptophan, a serotonin precursor, relieves depression, especially in combination with other drugs. However, Murphy *et al.* (1978) argue that the most recent data suggest that treatment with this precursor is less effective than other treatments. Evidence for a contributory interaction of the brain serotonergic system with tricyclic and MAO inhibiting drugs is growing. The serotonin synthesis inhibitor, parachlorophenylalanine (PCPA), reduces the therapeutic effect of drugs that usually lessen depression (Shopsin, Friedman, & Gershon, 1976).

Other Considerations

Various interactions of the catecholamines with serotonin have been proposed to account for depression (e.g., Mendels & Frazer, 1975; Prange, Wilson, Lynn, Alltop, & Stikeleather, 1974). Also, it is known that administration of the hormone cortisol is often complicated by the development of both manic and depressive symptoms (Carpenter & Bunney, 1971). Furthermore data suggest that depression can be precipitated by increases in cholinergic activity (Janowsky, El-Yousef, Davis, & Sekerke, 1972).

The clinical phenomenon of depression is, of course, quite complex, and there are numerous individual differences in its manifestation. In addition to the monopolar-bipolar distinction, cases of exogenous or reactive depression, that induced by some clear external stressor, have been differentiated from cases of endogenous depression, where an external stressor is not clearly present. A number of other such differentiations have been made (see Katz & Hirschfeld, 1978), and it is evident that individual differences in depressive symptoms are sufficient to render any classificatory scheme imperfect. Strauss (1975) has recommended a multiaxial approach to clinical diagnosis, which may more accurately account for the diversity of individual symptom configurations. We must also consider again here that conditions of depression are by no means perfectly correlated with suicidal intent (Beck *et al.*, 1975; Wetzel, 1976a).

In summary, conditions of affect are at least in part mediated by nonassociative factors. The fact that various drugs can rapidly alter mood alone should prove this. This does not negate a role of cognition and experience in affect. As is readily apparent to most of us through our own experience, position on the euphoria-dysphoria continuum (continua) may change rapidly in response to successes, failures, or other alterations in our fitness. Perception of success or failure appears to influence activity of various neuroregulators and neuromodulators, including but probably not limited to catecholamines and serotonin. Indeed, it increasingly seems likely that a wide variety of neurochemical and hormonal systems interact in complex balances to determine much of what we call motivation and emotion (see Barchas *et al.*, 1978).

Brain Reinforcement or Reward Mechanisms

Depression is usually considered to be characterized by a state of anhedonia or dysphoria, and suicide is usually thought to occur when such anhedonia or dysphoria is severe. Conceptually opposed to these states is the idea of reward, which generally entails something pleasurable or

beneficial to the organism. Psychologists have long studied the role of reward or reinforcement in behavior. They have defined these concepts variously, usually citing satisfaction of biological requirements of the organism and/or changes in response probabilities. Such definitions have suggested, but generally not expressly described, the relationship of rewards or reinforcers to biological fitness. The rewards or reinforcers of psychological experiments usually have consisted of access to food or water after deprivation, access to a sexual partner, access to safety after some aversive stimulation, or, in human experiments, access to more complex stimuli benefiting the individual. Most succinctly, reinforcers or rewards are events improving the biological fitness of the organism. Evolutionary pressures have structured organisms such that they approach stimuli that improve their fitness. Hence, it is not surprising that response probability is affected by events that are beneficial to fitness; organisms repeat successful responses.

One common characterization of suicidal individuals is that they are those experiencing unrewarding lives (e.g., Snyder, 1975). This fits the notions that have been developed in this book, in that those whose fitness is low are likely experiencing few events improving their fitness. Thus the vast literature on reward and reinforcement is quite relevant to the study of suicide. Of especial interest is the growing evidence on brain mechanisms in reward, particularly because this presents a picture that is fairly consistent with data on the physiology of severe depression, chronic stress, and suicide.

Self-Stimulation, Neurochemistry, and Reward

Olds and Milner (1954) originally discovered the phenomenon of self-stimulation in animals, a finding that has since shed considerable light on the physiology of reinforcement. With electrodes implanted in certain brain areas, rats press levers at dramatically high rates in order to receive electrical stimulation. Olds and Milner found that the medial forebrain bundle of the hypothalamus was the most effective area and the septal nucleus was also quite effective. Several other areas have been found to produce self-stimulation to some extent, whereas still other areas appear to be aversive insofar as rats will press to avoid their stimulation. It was originally believed that self-stimulation involved a tapping of reinforcement mechanisms in the brain, and this view is still prevalent today (Routtenberg, 1978).

Some of the most interesting data on self-stimulation come from pharmacological studies of the phenomenon and attempts to identify possible neurochemical systems subserving reinforcement mechanisms (see reviews by Mogenson & Phillips, 1976; Routtenberg, 1978; Stein, 1978). A major stimulus to this work has been the finding that most of the brain areas in which self-stimulation is effective are also areas in which the catecholamines

are present as neurotransmitters. In pharmacological studies it has been found that self-stimulation behavior is selectively affected by drugs that influence central catecholamines. Drugs that release catecholamines from functional stores (such as amphetamine or α-methyl-*m*-tyrosine) facilitate self-stimulation. Conversely, drugs that deplete catecholamine stores (reserpine), block catecholamine receptors (chlorpromazine, haloperidol), or inhibit catecholamine synthesis (α-methyl-*p*-tyrosine) suppress self-stimulation (Stein, 1978). Pharmacologic activation of serotonin or acetylcholine systems usually suppresses self-stimulation, whereas blockade of these systems usually facilitates the behavior, suggesting that these systems antagonize reward mechanisms.

In earlier research most of the pharmacologic agents that were employed affected both norepinephrine and dopamine. Much of later research has concentrated on defining which catecholamine specifically is involved in reinforcement mechanisms (see reviews by German & Bowden, 1974; Mogenson & Phillips, 1976; Stein, 1978). Much evidence was gathered in favor of the specific involvement of norepinephrine. For example, self-stimulation can be obtained with electrodes in the locus coeruleus, the site from which dorsal norepinephrine fibers originate, and with electrodes in the ventral norepinephrine pathway. Also, drugs believed to inhibit norepinephrine synthesis specifically, by affecting the enzyme dopamine-β-hydroxylase, generally have been found to block self-stimulation. However, several later experiments have challenged the conclusion that norepinephrine neurons are involved in self-stimulation, and instead point to dopamine as the neurotransmitter mediating reinforcement. Many areas in which dopamine is highly concentrated also support self-stimulation, whereas drugs with fairly specific blocking action on dopamine receptors will usually block self-stimulation. Stein (1978) has concluded that the joint activity of norepinephrine and dopamine systems is required for the successful performance of operant behavior.

Drug Self-Administration and Reward

The fact that many of the drugs that humans and nonhuman animals will persistently self-administer (see Schuster & Johansen, 1974) are catecholamine stimulants also suggests a role of catecholamines in reinforcement. Agents such as amphetamine and cocaine provide potent reinforcement for self-administration behavior. The reinforcing properties of dopamine in particular are indicated by demonstrations that apomorphine, a dopamine receptor stimulant, is avidly self-administered (Baxter, Gluckman, Stein, & Scerni, 1974). Self-administration of apomorphine, unlike that of amphetamine or cocaine, is unaffected by catecholamine depletion, but is blocked by

treatment with the dopamine antagonist pimozide (Davis, Smith, & Khalsa, 1975). Davis *et al.* (1975) find a similar pattern of results with the norepinephrine agonist clonidine. Self-administration of this agent is unaffected by inhibition of norepinephrine synthesis but blocked by the norepinephrine antagonist phenoxybenzamine. These data suggest again, therefore, that catecholamines may play a role in reinforcement processes in the brain.

Stress, Hormones, and Neurochemistry

An important set of data related to euphoria-dysphoria and affective state involves the effects of stress upon hormonal and neurochemical conditions. These effects are especially important to acute changes in emotion and more protracted states of exogenous or reactive depression. *Stress* can be defined for this purpose, as it has been previously in this book, as some demand made upon the organism's coping abilities.

The work of Cannon (1914) and especially Selye (1956) was important in development of the understanding of the physiological effects of stress. Stress of brief duration, such as a sudden change in the environment, produces activation of the sympathetic nervous system and release of epinephrine and norepinephrine from the adrenal medulla. Adrenocorticotropic hormone (ACTH) may also be released from the anterior pituitary during stress. With chronic stress, greatly increased release of ACTH induces glucocorticoid release from the adrenal. These hormonal changes generally act to increase blood glucose levels, favoring rapid action to cope with the stress, and in chronic stress may also lower bodily functions oriented toward reproduction, growth, and resistance to disease (Levine, 1976; Selye, 1956; 1973).

More recent evidence, much of which is drawn from animal studies, suggests that central neurotransmitter systems respond to stress in characteristic manners concomitant to the hormonal changes. Acute stressors may lead to a transitory increase in the activity of brain catecholamines, producing behavioral excitation, followed later by increased cholinergic and decreased catecholaminergic activity, producing behavioral suppression (Anisman, 1975, 1978; Carlton, 1969; Yuwiler, 1971). There may also be changes in the serotonergic system during acute stress, although these may not be as pronounced (Anisman, 1978; Yuwiler, 1971). During more prolonged stress, there may be an increase in monoamine synthesis, which possibly occurs in response to ACTH release, or a slowdown in catecholamine utilization, or both (Dunn & Gispen, 1977; Weil-Maherbe, 1972; Yuwiler, 1971). The effect of chronic stress may depend critically upon whether the stress is

escapable or inescapable; that is, whether or not a coping response is available to the individual. Chronic, inescapable stress appears reliably to induce monoamine depletions (Anisman, Pizzino, & Sklar, 1980; Weiss, Glazer, & Pohorecky, 1976).

Monoamines and Suicide

Monoamine depletions during chronic, inescapable stress are potentially quite relevant to suicide. First, such depletion is concordant with the notions that human reactive depression is stress-induced and accompanied by low levels of monoamine activity. Since suicide is generally characterized as occurring among those experiencing some chronic, inescapable stress, otherwise termed as hopelessness or desperation, it might be predicted that those committing suicide show low levels of brain monoamines. Indeed, related studies have been performed. Postmortem assays of brain monoamines and their metabolites have been conducted for suicides and control populations consisting of those who have died from other causes. These studies have recently been reviewed by Murphy *et al.* (1978) and Schildkraut (1978).

Serotonin

Shaw, Camps, and Eccleston (1967) analyzed serotonin levels in the hindbrain of suicides and nonsuicide controls, reporting a 19% reduction in levels among the suicides. Bourne, Bunney, Colburn, Davis, Davis, Shaw, and Coppen (1968) similarly reported a 9% decrease in serotonin in the brainstem, but this difference was not statistically significant. Pare, Yeung, Price, and Stacey (1969) reported an 11% reduction in brain serotonin in suicides, whereas Lloyd, Farley, Deck, and Hornykiewicz (1974) found reductions of 27 and 30% in two of six raphe nuclei, but no significant differences in other areas. Cochran, Robins, and Grote (1976) examined serotonin levels in several brain regions in a small sample of suicides and controls, examining both "depressed" and "alcoholic" suicides, finding that any differences did not reach statistical significance. Also, Beskow, Gottfries, Roos, and Winblad (1976) found lower serotonin levels in several brain areas of suicides as compared to controls, but these differences did not reach significance. The evidence thus suggests a reduction in serotonin in the brains of suicides, but is by no means conclusive. Some confounds may also be present. For example, in the study by Pare *et al.* (1969), the suicide group was significantly younger than the control group, which conceivably could account for the difference in serotonin levels. Also, treatment with psychoactive drugs such as MAO inhibitors and tricyclics may have occurred in some

of the subjects in a number of these studies, possibly affecting the validity of the interpretations.

The metabolite of serotonin, 5-HIAA, has also been compared in the brains of suicides and controls. Bourne *et al.* (1968) first reported a reduction averaging 28% of this compound in the hindbrain of suicides. Pare *et al.* (1969) found a 13% reduction in the brainstem of suicides, although this did not reach significance. Birkmeyer and Riederer (1975) reported decreased levels of 5-HIAA in those depressed before death, although these deaths were not suicides. A later study of suicides by Beskow *et al.* (1976) indicated lower 5-HIAA levels in several brain regions. However, in this last study a possible confound was indicated in that the time between death and autopsy was longer for suicides than controls, which conceivably could have been responsible for the 5-HIAA differences. The study of Beskow *et al.* also indicated higher brain 5-HIAA levels in females than males.

Catecholamines

Studies have also examined catecholamines and their metabolites in the brains of suicides. Beskow *et al.* (1976) found somewhat lower levels of norepinephrine in the putamen of suicides compared to controls, while in the frontal cortical lobe there were higher levels of HVA, a metabolite of dopamine. Birkmeyer and Riederer (1975) found decreased dopamine levels in the striatum, raphe, and nucleus ruber, and decreased norepinephrine levels in the nucleus ruber of individuals depressed before death, but these were not suicides. Moses and Robins (1975) reported data on norepinephrine and dopamine levels in 30 brain areas of depressive suicides, alcoholic suicides, and controls. The findings showed a slight increase in norepinephrine levels in four areas of the suicide brains, which the investigators considered to be of little clinical importance. In no case were norepinephrine or dopamine levels in suicide brains significantly lower than controls. In two other studies, norepinephrine levels in the hindbrain (Bourne *et al.*, 1968) and in hypothalamus, and dopamine levels in the caudate nucleus (Pare *et al.*, 1969) were found to be similar in suicides and controls.

It appears, then, that the evidence for serotonergic reduction or depletion in suicides is clearer than the comparable evidence for catecholamines. However, methodological considerations make it premature to draw strong conclusions at this point. Also, we must consider the common assertion (e.g., Shneidman, 1976a; Stengel, 1973) that suicide occurs during a period of relative activity following protracted depression, which may suggest a neurochemical change around the time of the act. In any event, the data regarding serotonergic activity in suicides are consistent with those suggesting monoamine depletion in depression and protracted stress.

Reserpine and Suicide

Another piece of evidence is suggestive of a role of monoamines in suicide. In clinical treatment the drug reserpine, which as discussed above depletes monoamines, used to be administered to schizophrenics and others to calm agitation. It has not only been noted that such treatment induced severe depression in a number of those receiving it (see review by Goodwin & Bunney, 1971), but that suicide occurred in some of these patients (Berger, 1967; Lester, 1972a; Weil-Maherbe, 1972). It is, of course, difficult to evaluate this evidence given that the extent of suicidal motivation among such patients prior to drug treatment is not known. Also, comparisons to matched controls given placebo treatment were often not conducted in such studies (Berger, 1967; Lester, 1972b). These reservations aside, this evidence would suggest that monoamine levels may play a causative role in suicidal motivation rather than simply be altered concomitantly to such motivation.

In summary, it appears that the catecholamines and serotonin may be intimately involved in the motivational and emotional dimensions related to success and failure in coping activities. Our best indications at present are that suicidal motivation derives from conditions of protracted and intractable stress, or failure to cope or receive rewards (see Chapter 5). All of such conditions may be associated with low levels of monoamine activity. An involvement of such nonassociative physiological processes in these behavioral dimensions would indicate that some innate factors subserve, in a more or less direct manner, aspects of suicidal behavior. Emotional dimensions that are well established to be related to suicide are not exclusively subserved by associative and cognitive factors.

Physiological Pain Mechanisms and Suicide

Another motivational and emotional dimension that at some level of analysis relates to self-destructive behavior is that involved in physiological pain or nociceptive information. Many of the basic mechanisms involved in pain are clearly innate. There are a number of reflexes facilitating avoidance of physiologically harmful stimuli, almost all animals respond to aversive stimulation by escape or avoidance, and there are identifiable pathways and structured in the nervous system that subserve pain information (Melzack, 1973; Pomerantz, 1973; Pourier, Bouvier,Olivier, & Boucher, 1968). Processes of pain, as well as those involved in punishment and avoidance of aversive stimulation, orient the individual away from events that potentially harm his biological fitness. They are the simplest and some of the phylogenetically oldest mechanisms that prevent the organism from engaging

in acts of a suicidal nature. Punishment processes and those involved in negative reinforcement (Fantino, 1973) elaborate upon simple pain reflexes in that future response probabilities are altered by past experience with aversive stimulation.

Pain Sensitivity, Endorphins, and Stress

Suicidal behavior must involve some circumvention of pain mechanisms. There are several relevant issues here. First, it is well established that despite the fact that most individuals share the same basic reflexes and physiological substrates of pain, different individuals may be differentially sensitive to the same amount of physiological damage (Melzack, 1973). Furthermore, the same individual may be differentially sensitive to the same amount of nociceptive stimulation at different times. One possible factor that is related to this is the degree of activation of the physiological systems involving biochemicals known as endorphins. Endorphins are recently discovered chemicals that appear to act as hormones and/or neuromodulators or neurotransmitters, altering pain sensitivity and possibly other aspects of behavior (see reviews by Barchas *et al.*, 1978; Goldstein, 1978). Endorphins are found both in the pituitary gland, from which they are released into the bloodstream with apparent hormonal action, and in the central nervous system. Larger molecules such as β-endorphin have been identified in the pituitary, and appear to share a common precursor with the hormone ACTH. Smaller molecules such as met-enkephalin and leu-enkephalin are found in many areas of the limbic system and other lower brain areas, and may serve roles as neurotransmitters or neuromodulators.

Endorphins were discovered in the process of investigation of the physiological substrate of the effects of opiates. Opiates, such as morphine, have long been known to reduce sensitivity to pain. Hughes (1975) reported evidence for the presence of opiate-like substances in the brain, chemically isolating those substances. Work in his and several other laboratories has confirmed the presence of these endorphins and pointed to their critical role in pain perception. It has been demonstrated that all of the endorphins have the ability to produce analgesia as well as tolerance and dependence (see Barchas *et al.*, 1978). However, they may differ in potency, with endorphins with higher molecular weights producing longer lasting effects. Some of the most interesting and relevant data indicate that β-endorphin is released during stress in conjunction with ACTH, and that there are parallel reductions in the pain threshold.

If pain sensitivity during stress is reduced by endorphins and other factors, it is conceivable that suicidal acts might be facilitated during stress. Suicide is

usually related to chronic stress (see Chapter 5), and it is possible that reduction in pain sensitivity because of such stress makes self-damaging actions more readily carried out. It is usually conjectured that pain reduction during stress or injury is adaptive because it allows the individual to perform whatever coping actions are necessary to improve his situation without being debilitated by pain. A wounded individual may not survive if he is left writhing in pain, but may survive if he can ignore his pain so that he can perform whatever coping activities that would improve his situation. However, it is also possible that, in a secondary manner, suppression of pain during chronic stress has come to be involved in self-damaging forms of behavior. The stress reduces factors that might inhibit such behavior.

Technology, Suicide, and Pain

There is another manner in which pain mechanisms relate to suicides. As has been argued in previous chapters, many of the technologies that are employed in suicide induce relatively painless death. This is especially true of modern methods such as barbiturate overdose. By employing such methods, an individual circumvents biological factors (i.e., pain-avoidance mechanisms) which normally would prevent self-destructive behavior. Again, this indicates that in novel environments, such as that provided by the availability of barbiturates, normal life-preserving mechanisms may break down. The reflexes and other innate mechanisms involved in pain and avoidance of aversive stimuli could not yet have become adapted to the presence of barbiturates in the environment.

Conclusions

In this chapter I have described how changes in mechanisms subserving reinforcement, positive affect, and pain avoidance are altered in chronic stress. Such mechanisms are those that normally orient the individual toward events enhancing fitness and away from events threatening fitness. In times of chronic, inescapable stress, which we know is the usual antecedent of suicide, such mechanisms are altered such that they are less conducive to life-preserving behavior. The evidence is, of course, incomplete and not entirely conclusive. Also, there are undoubtedly a variety of other, unknown processes that may relate to the life-preserving-life-threatening dimension of behavior. It would seem particularly likely that future work on neuroregulators and neuromodulators will further elucidate this behavioral dimen-

sion. However, it is probably not premature to conclude that various innate motivational and emotional substrates change as a function of success or failure in coping activities. These changes would relate to discussion in previous chapters about the effects of the environment on gene expression. During coping failure, these substrates appear to be altered such that life-promoting behavior is less probable and life-threatening behavior is more probable.

11

Ethics and Suicide

In this chapter I would like to consider two separate relationships between human ethics and suicide. The first is the role that societal ethics play in the determination of the act. Much of this discussion will derive from ideas in previous chapters about the role of culture and learning in suicide. The second relationship is the extent to which the scientific study of suicide might speak to the ethics of suicide.

Ethics as Modulators of Suicide Frequency

In Chapters 2 and 6 it was discussed how suicide appears to occur at a significant frequency in most cultures, despite positive or negative societal attitudes toward the act. Nonetheless, there is an apparent moderate correlation between suicide frequency and social attitude. There are several available discussions on the relationship of legal and religious mores to suicide (e.g., Diggory, 1968; Dublin, 1963; Lonsdorf, 1968; Rosen, 1971; Shaffer, 1976; Westermarck, 1908). Suicide rates are generally low in Moslem countries, where there has traditionally been strong condemnation of suicide in any circumstance. Rates are also low in Ireland and many countries of Southern Europe, where Catholicism may operate against suicide. In parts of the Orient, especially Japan, attitudes toward the act are more favorable and rates are high. High rates also characterize Protestant European countries where strict Christian attitudes toward the act might be somewhat more relaxed (see Table 2.1 on p. 14).

It is difficult to assess whether rates affect the attitude or vice versa, but it is quite conceivable that the dominant social attitude influences the frequency

of suicide, reflecting a human propensity to conform to social pressures. The church in Christian countries often appeals to those that are experiencing difficulties in adapting ("Come unto me all those that are heavy laden. . ."). As such, it may influence some of those that potentially would be suicidal. Organized religion may provide a conceptual framework and social structure that give relief to the fitness difficulties of many individuals. It aspires to provide purpose to life that may otherwise begin to lose meaning. Perhaps more importantly, it provides social contact for the socially isolated, hence relieving one of the major factors known to be an antecedent of suicide.

Therefore, the church operates against suicide in two manners. First, it teaches a conceptual framework that makes suicide an invalid and improper action. Suicide is a sin because it is a violation of the commandment "Thou shalt not kill." It is an action that ostensibly threatens the individual's fitness by reducing his or her welfare in the promised afterlife. If individuals believe these teachings, they should become less inclined toward suicide to the extent that they will generally not behave in a manner threatening their *perceived* fitness. The second influence of the church is to provide some relief to the true antecedents of suicide. By conceptually giving the individual some ostensive purpose for life and increasing the degree of integration into a social network, it may relieve the root causes of the act. It furthermore teaches hope where hope may previously have been lost. When individuals have been unable to promote their fitness through concrete actions, they are given the hope that prayer may affect the state of the world to their benefit. The belief in the efficacy of prayer gives belief that uncontrollable dimensions of the world may be controlled.

Suicide is accordingly an unchristian and atheistic act. True despair is against the dominant religious tenets of Western society because it is inconsistent with faith in God. The church thus may exert an influence on the frequency of suicide by altering individuals' conceptions of themselves and their fitness. In a more concrete manner, it may directly improve the fitness of many individuals by improving their social status. Generally, Christian religion would thus serve to decrease the probability of suicide. There may be unusual sects and individual religious beliefs that act to increase the probability of suicide, such as in cases where beliefs about the goodness of the afterlife encourage the act. However, the usual effect of Western religion may be to operate against pressures causing suicide to occur.

This point further underscores the importance of perceived fitness as opposed to actual fitness in producing suicide. The fact that institutionalized social mores may alter people's conceptions of their own welfare, away from the true biological status, indicates that humans are suggestible and that cognition is of paramount importance in the determination of human behavior. An important empirical question is whether the more concrete

changes in biological fitness effected by religiosity are more important in influencing suicide than the less tangible conceptual changes it may also effect. To what extent is the influence of the church over behavior due to conceptual changes it induces as opposed to concrete social benefits it might offer to some individuals?

Another point that could be drawn is that suicide occurs despite the fact that it is contrary to the dominant moral system of the society. This suggests that the moral system's effect on the incidence of the act is a secondary one. More broadly, to some extent it argues against the primary determination of suicide by learning, cognition, and culture (see Chapter 6). The dominant effect of these latter factors may actually be against suicide. We learn that suicide is an illegal, immoral, and socially undesirable act in Western culture, yet a large number of individuals continue to die in this manner. There may be some overstatement in this. The Christian religion also lauds martyrdom (see Dublin, 1963), which gives some ambivalence to the attitude toward the act of suicide. Also, the continuing occurrence of suicide provides models for imitation, thus, some cultural dimensions may favor the occurrence of suicide in opposition to the effect of religion.

Similarly, suicide is contrary to Jewish and Islamic teachings and occurs despite these teachings. The religion's dominant effect would be to lower the probability of the act, which would suggest that the factors inducing suicide derive from something other than the overt teachings about proper behavior in the culture. Again, this suggests that the dominant culture's teachings compete with other factors that favor the occurrence of the act. In Oriental cultures the societal teachings have often been more favorable to the act (Iga & Tatai, 1975; Seward, 1968; Venkoba Rao, 1975). While high rates have accordingly been found in countries like Japan, these rates are in the same range as those found in Europe and North America, where Christian attitudes have prevailed. This may suggest again that social and ethical teaching are not the exclusive determinants of suicide frequency; rather, these may act only as secondary modulators of this frequency.

Religious and other ethical systems also impose selection pressures that may over generations affect the frequency of behavioral patterns in a society (see Chapter 9). Whatever tangible sanctions they impose may adversely affect the inclusive fitness of those transgressing their codes; they may also confer benefits favoring the inclusive fitness of those behaving within these codes. A particular ethical system may find its strongest advocates in those whose fitness is most enhanced by that system. A stable ethical system, despite its artificialities, may benefit a society as a whole, however. The cooperativeness and altruism preached by many modern religions may enhance the general societal welfare insofar as a cooperative society may better distribute its resources among its members than would one plagued by

petty competitiveness. Presumably, on the whole, ethical systems that are advantageous to the collective welfare of adherents will survive and flourish, whereas less advantageous ethical systems will not gain adherents or will decline.

Ethics of Suicide

Suicide Prevention Movements

I would like now briefly to consider the more difficult question of how the discussions of this book address social policy or ethics concerning suicide. The study of suicide in Western culture has long been linked with the study of suicide prevention. Most of the major texts on suicide today devote a considerable amount of discussion to an advocacy of certain methodologies for the reduction of suicide frequency in society (e.g., Berg, 1972; Dublin, 1963; Fox, 1976; Kiev, 1976; Motto, 1972; Shneidman, 1972). Suicide is assumed to be an undesirable social problem, and this assumption is rarely acknowledged as such. This may stem from the fact that suicide is often studied by psychiatrists and social workers, whose sciences are essentially value laden. It furthermore reflects the fact that the prevailing attitude toward suicide in Western society is a negative one. The act is viewed as something to be eliminated to improve the collective social welfare. This seemingly unquestioned assumption further indicates that suicide is an action that can occur without the overt encouragement of society.

The attitude that suicide is undesirable may in part derive from a misunderstanding of the personal situations of suicides and a faulty projection of self onto others' circumstances. An individual who is coping fairly well, as perhaps do most individuals in the modern situation, may have little conception of the difficulties experienced by others. Such an individual may realize that suicide would for himself or herself be a quite undesirable act, since it would reduce inclusive fitness. This person might not realize the extent to which others may be precluded from coping; consequently he or she may believe that suicide is also undesirable for others. If one is coping well and observes that most others cope well, one may not be able to understand the behavior of those not coping well. In learning of suicides, he or she may accordingly view the act as irrational and undesirable.

Another reflection of the modern Western societal attitude toward suicide is the growing number of prevention and counselling centers whose expressed role is to reduce the incidence of this behavior. For example, Fox (1976) describes the Samaritan movement in Britain, whose role is to counsel potential suicides, primarily by telephone. The organization works

on the basis of "befriending," which is designed to reduce the social isolation of clients. Similar organizations are found in many parts of North America and Europe (see, for example, Resnik, 1968; Ringel, 1968; Shneidman & Farberow, 1968).

Prosuicidal Movements

In contrast to this attitude is that of movements in Britain and North America, recently publicized in the news media, who wish to disseminate information that would facilitate painless and reliable suicide. The purpose is to promote a voluntary euthanasia for those with unsolvable difficulties. It is believed that suffering can be relieved by promoting suicide and effective means of inducing it. At a time when the human population continues to expand rapidly, with a consequent decrease in the resource per capita ratio, such prosuicidal movements could grow in influence. The extent to which such movements can alter the frequency of suicide may provide further information about the role of learning, cognition, and culture as determinants of the act.

Given that suicide is a species-wide phenomenon, that it has probably occurred for much of the species's history, and that it occurs at some rate even when it is viewed negatively by society, the potential efficacy of any suicide prevention movement might be questioned. These facts would seem to suggest that the phenomenon is at least partially immalleable. LaFontaine (1975) appears to be taking this position in an article on the anthropology of suicide. LaFontaine suggests that the literature from social science indicates that "some suicide is 'normal' in a community." Furthermore, the institution of suicide may "be said to have a positive function for the society in that it rids the group of members who have outlived their usefulness and may become a social burden . . . . Whether one accepts this argument or not, suicide cannot be considered a social disease comparable to diseases of the body and equally susceptible to treatment [p. 89]." LaFontaine questions whether suicide is pathological in nature, pointing out that not all cultures view it so and that there is also no complete consensus on this view in Western society.

Many of the arguments presented in this book could be taken as support for LaFontaine's argument. Suicide frequently occurs where it is least maladaptive in a biological sense, among those that have already experienced genetic death. It consequently may benefit the larger society because it extracts from the population individuals consuming resources but without productive and reproductive potential. Nonetheless, there is a minority of cases that occur where the inclusive fitness of the individual may be adversely affected by suicide and where productive potential for the society may be

lost. It could be argued that suicide prevention efforts might best be directed toward these exceptional, truly maladaptive cases.

The intent in this book is not, however, to advocate any ethical stance toward suicide. The logic of ethics can confound science, and remaining with a descriptive and explanatory approach rather than an evaluative approach may be in the best interests of scientific advancement. Ethics have been traditionally viewed as apart from objective science. In describing relationships between suicide and other events and developing hypotheses about these relationships and events, no statement about the desirability of future suicides need be made. There have been modern articles that have dealt with the morality of suicide (e.g., Brandt, 1976), and the older, historical literature is of course replete with treatises on this subject. But discussions of morality and ethics in absolute terms seem to have little meaning for the modern scientist. No objective standard of morality is universally accepted, and at best we can make objective statements only about the consistency of behavior with a particular society's dominant ethical code.

Evolutionary Ethics

However, evolutionary biologists have since Darwin's time flirted with the idea that ethics may ultimately become a division of biological science (see Edel, 1955; Quinton, 1966; E. O. Wilson, 1975). The earliest attempts included those of Spencer (1892) and Stephen (1882), who constructed large-scale ethical systems on the basis of general evolutionary theory. Spencer essentially advocated a laissez-faire social philosophy, suggesting that the able would rise to the top and the unfit would fail. Interference with this process was a violation of nature's moral law. Stephen spoke of social health and the vitality of the society as the criteria for setting moral standards. Kropotkin (1902) emphasized, in contrast to Spencer, the role of cooperation in human development and survival, and portrayed human history as a rising tide of mutual aid. But the whole movement lost prominence, according to Quinton (1966), with the publication and impact of Moore's (1903) refutation of ethical naturalism. Moore argued that the concepts and propositions of morality were radically distinct from those of natural science.

Some more recent attempts to revive evolutionary ethics as a discipline (Huxley & Huxley, 1947; Waddington, 1942, 1960) have not received a lot of attention from moral philosophers. J. S. Huxley has argued that ethics themselves evolve. Evolution has a direction, toward a higher degree of organization, and Huxley argued that this direction should be fostered by human society. Huxley realizes that there are many possible future lines of evolutionary development, and says that human action should be oriented toward the promotion of higher values to protect the welfare and dignity of

the individual. Quinton (1966) has argued that Huxley does not clearly state how his values for future human development are derived from biology. Waddington (1942, 1960) suggests that the general trend of evolution is discoverable and that the ultimate justification of moral beliefs is to be found in furthering this trend. Waddington argues that the fundamental criterion of value is what evolutionary biology shows to be most efficient. The biologically efficient is what best promotes the general trend of evolution, although this general trend is not really defined in Waddington's arguments.

E. O. Wilson (1975) said that, "Scientists and humanists should consider together the possibility that the time has come for ethics to be removed temporarily from the hands of the philosophers and biologicized [p. 562]." There is good reasoning behind this statement. *Ethics* is simply an abstract concept pertaining to attributes of the behavior of a particular biological species, *Homo sapiens*. The behavior can be studied objectively as another aspect of science, so why cannot the dimension of social conduct be so studied? In the modern situation we are able to make much more knowledgeable statements about evolution and behavior than was possible in, for example, Spencer's time. Consequently, ethical systems we could derive might be much more sophisticated than earlier attempts. There can be little doubt that the future will bring even greater insight into the evolutionary dimensions of human conduct; the ethics may accordingly develop in conjunction with the science.

There are several manners in which science may have input into the decision-making processes determining the general form of future human conduct. We can define, more or less, the biological fitness of individuals and social groupings by examining reproductive and productive prospects. Accordingly, behavior can usually be classified as adaptive or maladaptive. Few would argue with the desirability of adaptive conduct and conduct that does not harm the welfare of the species. Science can define the most efficient manners in which individual and group fitness can be promoted. Biological science, however, may also tell us that some coping difficulties are inevitable. Some individuals in each generation may fail to thrive for a variety of reasons, no matter how successful the general nature of societal adaptation. Competition among individuals may inevitably produce both new forms of success and new forms of failure. It is not my purpose here to outline a course for scientific ethics, which would require very detailed arguments, but to suggest that such a discipline may have merit. One reservation, however, is that any set of general principles may be doomed to failure simply because they are general. The input of science into decision making about future conduct may require a weighing of all relevant and available data specifically for each problem that arises.

Within this context, it might eventually become possible to speak of the ethics of suicide in a scientific manner. However, the field of biological ethics

is so poorly explored and controversial that any such analysis might be premature at this point. If there is a lesson from the perspective toward suicide developed in this volume, it is that many, if not the majority, of its instances are not entirely outside of the normal framework of adaptation. Furthermore, the occurrence of suicide at some rate in any society seems to be almost inevitable, at least as inevitable as the fact that some individuals will experience unsolvable coping problems. If it is desirable to reduce the frequency of suicide, this may be best accomplished by changing underlying social factors. This might include measures to reduce availability of means to effect impulsive suicide, to reduce factors conducive to social alienation and lack of contact with kin, to counsel individuals to improve their coping strategies, and to reduce unjustifiable departures from an environment like that of our ancestors. However, some of these social changes might carry many other costs, making the calculus involved in deriving social policy quite complex. Perhaps a second lesson is that prevention efforts should focus on the truly maladaptive minority of suicides. Suicides that relate to transitory coping difficulties that only seem insolvable, that are caused by excessive imitation of others rather than true fitness problems, or that are impulsive acts may well be undesirable in a biological sense. A suicide prevention program focused upon truly maladaptive cases of suicide may be biologically well justified.

12

Limitations and Qualifications

I would like now to revisit a number of the topics discussed in previous chapters to give some elaborations and qualifications. This should serve both to forestall some potential misinterpretations and to point out possible weaknesses to be addressed in future research and theorization. I have attempted to bring the study of life-threatening behavior closer to the theoretical framework of natural science. Because this is a fairly novel enterprise, undoubtedly there will be errors and misplaced emphases. The scrutiny of subsequent research and interpretation will hopefully correct this, and at best my interpretations will serve in an heuristic fashion to broaden the scope of future analyses.

Suicide and Genetics

One potential misinterpretation is that I have suggested that suicide is largely mediated by genetics. Related to this was Dawkin's (1980) suggestion that the problem outlined in my original article on the biology of suicide (deCatanzaro, 1980) might only be a valid issue if some genetic factor mediated suicide. I would argue to the contrary. It is by investigating bizarre forms of human behavior, such as suicide, that we are likely to clarify the relevance of sociobiological and evolutionary theory to complex forms of human behavior. We will through such analysis gain insight into whatever unique aspects of human behavior allow suicide and other anomalous behavior to occur. This is true no matter what the ultimate and proximate causes of suicide prove to be. Whether these causes strictly involve learning, culture, and cognition on the one hand or a large innate component on the

other, the science of human behavior will profit from analysis of apparently anomalous behavior within a biological context. As E. O. Wilson (1978) suggested, it is possible to develop a sociobiology of purely cultural processes.

I have argued that suicide derives from a synergy of human culture and innate predispositions, not that either variable predominates. Technological and cultural evolution appear to have expanded the human behavioral repertoire to include potentially life-threatening acts. They furthermore have placed individuals in ecologically novel environments, unlike those in which their ancestors were selected, imposing a new range of selection pressures. It presumably became possible for human beings to engage in self-damaging acts when they were able to tie clothing or rope around their necks, to conceive of drowning themselves, and more recently to take a painless drug overdose or drive a car into a tree. The social ecology of such new behavioral possibilities, however, appears to conform to adaptive pressures. Suicide is most likely in those experiencing some inescapable stress, and as such it is not maladaptive in a biological sense since it does not subtract reproductive and productive potential from the population. If life-threatening behavior is considered to be a form of gene expression, this gene expression generally occurs where it is biologically least harmful.

Exceptional Cases

There is, however, some overstatement in this idea. Suicide does occur in some individuals with residual reproductive and productive potential. Some of the cases occurring among children, adolescents, and young adults must surely fit into this category of exceptions.

For example, consider the high frequency of suicide among individuals at prestige universities (Seiden, 1966). Such students have been preselected for outstanding academic potential. Although many of them may fail to excel in competition with others of high intellectual caliber and may experience other social and reproductive problems, they probably retain considerable productive potential relative to members of the society at large. Their suicide is engendered by coping failures relative to much higher standards than are generally present in the population. Hence some value to the community or population is probably lost through such suicides. Other examples can probably be collected through a careful examination of case studies. Suicide among some other gifted individuals may occur because of failure relative to unrealistic or excessively high expectations. Suicide among children, although quite infrequent, may occur before productive and reproductive potential is established. The social difficulties of many adolescents and young adults committing suicide may often be potentially transitory. Such in-

dividuals may despair of their situation because of factors such as false impressions of their abilities to cope in future, misinformation derived from unusual learning experience, excessive imitation of others, or transitory pathologies.

In these cases, whatever adaptive mechanisms involved in suicide appear to misfire. Coping failures of a sort are involved in the suicide, so that the basic stimulus conditions evoking the act resemble those of cases where the coping difficulty is more severe. That is, suicide occurs because of apparent coping difficulties that are not sufficiently debilitating or permanent to be truly associated with very low biological fitness. It is also possible that in some cases there are only trivial coping problems, although cases of this nature are difficult to find in the literature.

An occasional misfiring of the factors conducive to suicide is indicative of an imperfection or impreciseness of adaptive processes. The majority of instances of suicide may occur where biological fitness is not adversely affected, but a minority of suicides may be more biologically maladaptive. The general process may have arisen because of its usual effect, with the more maladaptive cases being a by-product. Genetic and experiential factors conducive to suicide may be differentially concentrated in different individuals, meaning that different stress-thresholds may be necessary for the occurrence of the act. Some individuals, because of their affective structure and personal histories, may be prone to commit suicide in only mildly adverse circumstances, whereas others may require exceedingly adverse circumstances before suicide is contemplated or indeed may under no circumstance commit suicide. Genetic recombination and chance distribution of environmental events may be responsible for this variance. The selection factors preventing some suicides but tolerating others may have only worked in a rough manner to determine the overall pattern, whereas some individual cases may be at variance with the general trend.

Life Out of Context

We must again consider that in the modern situation the human species is in some respects out of biological context. The species has been in transition throughout its recorded history, and is especially so in modern times. The demands of modern living, experienced especially by some members of the population, may derive from existence in circumstances unlike those in which our ancestors existed. Dawkins (1980) and Hamilton (1980) have likened this to the situation of caged and domestic animals, whose behavior is also frequently maladaptive. Dawkins (1980) draws the analogy of the moth that flies to its death in a flame; the moth's phototropism is adaptive in

its natural habitat, but with human alterations introducing the novel stimulus of fire, the behavior is expressed in a maladaptive manner.

Such existence out of biological context may facilitate the occurrence of the occasional suicide that is quite maladaptive in a biological sense. The student at a prestigious university, who commits suicide because of failure in that context, may be showing behavior derived from his or her ancestors' quite different circumstances. Were the student stressed and socially isolated and failing within a community of several hundred years previous, the act of suicide may have been less maladaptive. The community in all likelihood would have contained many of his or her kin, and coping failure in that context might have made him or her burdensome to kin. In this older context, prospects for coping would also have been less likely to change within the lifetime. Thus an individual may interpret rejection and coping failure in the modern context as the occasion for suicide, whereas this interpretation would have been determined by adaptations to circumstances in previous human evolutionary history.

The social context in which many individuals exist today accordingly is a departure from their ancestors' social situations. Certain critical social dimensions may resemble the ancestral situations, evoking suicide in somewhat novel contexts. In the past, the usual social context was generally more stable throughout an individual's lifetime and involved much greater contact with kin. In such ancestral situations, rejection by others, severe coping difficulty, social isolation, and reproductive failure may have meant that an individual's existence was harmful to the fitness of that individual's genes as they exist in kin. Consequently, suicide may have been a relatively adaptive process. The modern situation may be such that suicide may occasionally involve some loss of biological fitness.

Another major respect in which modern human life may be out of context is the fact that the average life span is greatly increased. This means that human genes in older ages are being expressed in circumstances unlike those in which they have been selected. Accordingly, we should expect some incidence of non-life-threatening behavior in older age ranges more common today than in the previous history of the species. This would mean that more maladaptive cases of suicide could occur in older ages; some potential fitness might be lost from the population through such suicides. These suicides could be viewed as being pathological to the extent that this term connotes biologically maladaptive behavior occurring through exposure to demanding or novel environments.

Still another manner in which we are out of context is in terms of technology. The ready availability of tools for effecting relatively painless death puts individuals in biologically novel circumstances. Selection in previous evolutionary history could not prepare us for the most modern

technologies of effective suicide, although some adaptation to older technologies should have occurred. This question could be investigated through a comparison of the degree of biological fitness of those committing the act in previous periods of history and those doing so today. Unfortunately, such an investigation would be limited by its retrospective nature and the incompleteness of historical data. Also, some suicides in any generation are likely to have occurred due to transitions during that generation. Social and ecological change, as well as competition, probably have occurred to a greater or lesser extent in most generations. This would mean that some "transition suicides" might be present in any generation; these suicides would be potentially pathological in that some residual biological fitness could be lost, although biological maladaptiveness need not be characteristic of all transition suicides. It might also be predicted on this basis that suicide would be most common during eras of social change or ecological instability. This notion would certainly accord with the sociological ideas that suicide occurs with social instability (Durkheim, 1951; Gibbs, 1957; Henry & Short, 1954; Meer, 1976). The other way in which the relationship between ecological transitions and suicide could be examined would be by studying modern cases, the technologies employed in these cases, and the historical novelty of the circumstances of these cases. It might be hypothesized that modern acts involving newer technologies and novel situations might extract more biological fitness from the population than acts involving older technologies and stresses that have repeatedly occurred in the species' history.

Limits on the Predictive Nature of the Hypotheses

Clearly, not all individuals commit suicide after experiencing a loss of reproductive potential, of capacity to work toward the benefit of kin, and of ability to produce toward the community's benefit. Many individuals may experience severe impediments to their ability to cope but nonetheless continue to behave in a life-preserving manner. The degree of stress necessary to induce suicide in some individuals may be exceedingly high, whereas others may not commit suicide under even the most adverse conditions. There is substantial interindividual variance in this characteristic. The extent to which this variance is attributable to innate differences or differences in learning experience remains an open question; evidence for both possibilities was discussed in previous chapters.

There are several examples where suicide might be predicted but where it generally does not occur. For example, suicide is said to be uncommon among the mentally retarded (Stengel, 1973), although data on this point seem to be sparse. Also, Neuringer (1976) concluded that there is no real

correlation between level of general intelligence and suicide, although again the data do not appear to be conclusive. It is known that suicide does occur among the highly intelligent (Shneidman, 1976b). It might have been predicted on the basis of hypotheses developed here that suicide would be negatively correlated with general intelligence. Those of lower intelligence would presumably be more frequently unable to cope with their situations. However, there are several reasons why this negative correlation may not be present. Modern society may demand more of its most capable members, making intelligent individuals more often stressed than less intelligent individuals. Also, highly intelligent individuals may be more prone to social isolation when in situations where their peers are less intelligent. The retarded are often protected from more severe stresses; their needs are frequently provided for in sheltered environments in modern societies, which would reduce the extent to which these individuals are stressed. Also, a cognitive contribution to the etiology of suicide could be less likely to occur among the less intelligent. Some ability to conceive of the act and understanding of methods employable in the act are necessary for effecting suicide; relative cognitive deficits among the less intelligent in the population may make complex, discrete acts of suicide less likely in these individuals. However, in Chapter 16 I will discuss self-injurious acts among the retarded, which conceivably represent crude, chronic acts of suicide, although other explanations of that phenomenon are much more parsimonious.

The Frequency of Suicide

It was pointed out in Chapter 2 that the official statistics from modern nations indicate that completed suicide is the cause of death in 1-2% of all deaths. It is a single, discrete behavioral event that by definition occurs once in a lifetime. Is this a sufficient frequency for the act to have come under the influence of selective pressures? This question is difficult to answer given the state of infancy in the science of human behavioral evolution. There must be some limit to the fineness of determination of behavioral predispositions by selective pressures. Defining this limit and the interactions with learning, culture, and cognition are the major challenges to this new science. A number of points are relevant here. First, the data reviewed in previous chapters do suggest that suicide relates to biological fitness parameters; this in turn suggests some alignment of the behavior with biological pressures. It also seems most likely that this alignment occurs primarily because of indirect effects of selection on the behavior. Given that individuals are born with behavioral predispositions orienting their behavior toward their inclusive fitness, they are likely to acquire behavioral attributes favoring this fitness.

Suicidal behavior may usually be acquired when it is least likely to threaten fitness. Thus, selection may act on the general motivational orientation of behavior, whereas specific behavioral patterns within this framework may be learned.

It will also be argued in later chapters that other forms of self-damaging acts may extend the frequency of self-destructiveness in the population. This greater incidence may make the phenomenon of sufficient dimensions that it would have to come under some influence of natural selection.

Biases in Statistics on Suicide

Douglas (1967, 1971, 1980) has argued that there are several biases in the official statistics on suicide. There is undoubtedly much truth in this. Some occurrences of suicide may not be recorded because of equivocal evidence, attempts to conceal the nature of the act by others or the suicidal individual himself, or unclear definitions of suicide. Some deaths labeled as suicide may actually be murders or accidents. Douglas has discussed these and other biases in detail. Unfortunately, it would be difficult to assess entirely the influence that these biases might have upon the conclusions that have been drawn here. At best, tentative conclusions can be derived from the most accurate data available, and as the data are improved these conclusions may be modified. Some suggestions about new data collection procedures are made in Chapter 17. It should also be noted that Douglas (1980) suggested that removal of the biases might increase the strength of my arguments.

Is Suicide a Unitary Phenomenon?

Hankoff and Turner (1980) and Blanchard (1980), in comments on my earlier article on the biology of suicide (deCatanzaro, 1980), suggested that the phenomenon might be too heterogeneous to be addressed in the manner I have proposed. I believe that there is room for a considerable degree of diversity in the nature and motivations of the act within a biological conceptualization. Diversity is a characteristic of most biological phenomena. Where the causation of a phenomenon involves a synergy of several factors, as has been argued here for suicide, it is not unlikely that the balance of determinants differs across individual cases. One suicide may well derive predominantly from altruism, another from an aberrant degree of imitation of others who previously committed suicide, and a third from pathological behavior induced by stress. Nonetheless, the literature does suggest a com-

mon thread, that some sort of coping difficulty occurs as an antecedent of the act in the vast majority of cases. The phenomenon is also unitary to the extent that it is primarily a human phenomenon deriving from unique attributes of this species. At a general level of analysis, the phenomenon is unitary; at finer levels of analysis, much diversity is possible.

The Species Generality of the Phenomenon

It is tool use in the act and verbal statements of intent that make suicide conspicuous as a form of death among humans. The survey of the relevant animal behavior literature in Chapter 4 suggested that it was difficult to identify forms of true suicide in nonhuman species. However, this was qualified in that nonhuman analogues of suicide may not have been identified because of incompleteness of the ethological and laboratory data. Also, some acts of suicide among nonhuman animals may be almost unidentifiable because they resemble others modes of death. If future research reveals that some suicides do occur in other species, it would not necessarily threaten the validity of many of the arguments developed here. It would, however, weaken the assertion that suicide arose with the expansion of the human behavioral repertoire accompanying increased tool use and a growing capacity to learn.

Members of other species may also arrive in situations where they are no longer capable of behaving toward improvement of their inclusive fitness. This may well be the occasion for death from some cause, as would be predicted by the Medawar-Williams hypothesis and other arguments made in Chapter 8. There are, however, several relevant dimensions characterizing the human situation that might not be present in many other species. The examples of tool usage and behavioral flexibility were discussed in Chapter 6. The degree and form of interdependency among human individuals may also be unique, such that those unable to achieve successful social interactions may be especially stressed, deprived of the opportunity to advance their fitness, and/or prone toward altruism. Other relevant and unique human attributes include an especial ability to imitate and learn through observation, a capacity to behave altruistically, and existence in an almost perpetual state of cultural and ecological transition. Furthermore, it may take an intelligent animal to know when the situation is hopeless, to realize that purpose for life is removed in those circumstances, and that death can be self-induced.

Cognition, Learning, and Culture Revisited

An involvement of nonassociative emotional and motivational changes, brought on by intractable stress at a proximate level and by changes in gene

expression derived from selection pressures at an ultimate level, is not incompatable with a role of cognition and learning in suicide. Suicide may derive from a synergy of these many factors, with a somewhat different balance of factors being involved in each individual case. One likely possibility is that the inherited emotional and motivational structure is such that it only determines in a general manner the orientation of behavior toward biological fitness. The loss of the capacity to promote fitness may produce a state wherein behavioral adaptiveness may break down, but the specific topography of behavior in such circumstances may be determined by learning and culture.

In the modern situation, it may be the perception or belief that effective coping is not possible that is more important than an actual state of low biological fitness. Seligman's (1975) notion of "learned helplessness" may be relevant here. An individual's learning experience and perception of events may be such that he or she believes his or her behavior to be ineffective. In future, adaptive behavior breaks down because of the perception of helplessness. Seligman relies on a cognitivistic and associational interpretation of this motivation change; the individual sees no point in attempts to cope when previous attempts have failed. While there may be some role of learning and cognition in this process, there is increasing evidence that nonassociative physiological changes occur during coping failure and that these changes may directly induce motivational changes, as was discussed at length in Chapter 10. Perception of coping failure may thus induce general motivational changes leading away from a life-preserving pattern; the specific behavior shown following such changes may depend on learning experience and culture.

13

Suicide: A Synthesis

In this chapter I would like to summarize and integrate the interpretations of human suicide presented in previous chapters.

The State of Modern Suicidology

Various academic disciplines have developed a variety of perspectives toward suicide. Each of these perspectives has had both merits and shortcomings. Many of the shortcomings derive from a lack of a general theoretical framework that allows integration of data and theory from the diverse disciplines.

Psychiatrists, clinical psychologists, and social workers have viewed suicidal phenomena from the essentially value-laden approach of their disciplines. This position appears to reflect the dominant modern Western attitude that suicide is one of several pathological and socially undesirable entities (see Chapter 11). This derives in part from a medical model of behavioral pathology (see Davison & Neale, 1978; Knopf, 1979) that has been extrapolated from physiological pathologies and infectious diseases to a variety of behavioral conditions. Collectively as a society we have attempted to improve the general level of coping of our members through medical and clinical activities.

Modern psychology has experienced much progress in the understanding of abnormal behavior, but too infrequently has addressed the theoretical problem posed by suicide. Psychodynamic models have focused upon interactions of cognitive variables and ostensive biological instincts. However, the theoretical assumptions and hypothetical constructs of this area of inquiry

have in many cases become highly questionable, while there have also often been weaknesses in the methodology of data collection and analysis. Learning theorists have attempted to determine the etiological and maintaining conditions of objectively definable behavioral states, but have rarely attempted an explanation of suicide. The modern cognitive school of psychology is developing some scientifically rigorous approaches to abnormal behavioral states, but has not been adequately integrated with approaches of other areas. The psychobiologists, psychopharmacologists, physiological psychologists, and behavioral geneticists have infrequently addressed the phenomenon of suicide, but have provided some stimulating insights into relevant dimensions of human motivation and conduct. More communication is needed among the subdisciplines of modern psychology, and a general theoretical framework might facilitate the integration of the diverse approaches.

The sociologists have described the social dimensions of suicide and other forms of deviance, providing a valuable, more global perspective toward these phenomena. Durkheim (1951) collected data on the social ecology of suicide that have since been replicated with remarkable consistency in studies of suicide in modern Western cultures. Durkheim provided direction and purpose to modern social science, focusing on social rather than more proximate determinants of suicide, but he did not venture to address ultimate evolutionary causation. Dublin (1963), Douglas (1967), Gibbs (1957), and Meer (1976) have also made outstanding contributions to the sociology of suicide, as have Farber (1968) and Lester (1972b) to the psychology of suicide. Yet the need for a deeper explanation and integration of the disciplines remains.

The anthropological literature provides many potential insights into human suicide; however, the phenomenon has infrequently been addressed by those in this discipline. Notable exceptions are found in the book by Bohannan *et al.* (1960), in the early work reviewed by Steinmetz (1894), Leighton and Hughes (1955), and Westermarck (1908), and in studies of Elwin (1943), Firth (1961), and some others. This work requires more attention from suicidologists from other disciplines, and especially in any attempt to assess the global incidence and nature of suicide.

Potential Contributions of Sociobiology

The sociobiologists and behavioral ecologists have never really addressed the phenomenon of human suicide. But their framework has the potential to subsume that of all of the other disciplines. It provides the synthetic, global approach that could unite the findings from the relevant disciplines.

Sociobiology is a discipline, not a theory. There are competing theories within the discipline, with some generally accepted basic tenets and assumptions deriving from evolutionary theory. If we accept the evidence for biological evolution and the fact that humanity exists as a function of such evolution, there is reason behind efforts to view more specific human traits as they relate to pressures of natural selection. But the discipline is dynamic. It must change to accommodate new data. In particular, as the theoretical framework derived from the study of nonhuman species is extrapolated to humans, substantial theoretical modification will be required to suit the unique nature of humanity.

Washburn (1978) has eloquently told us that humans differ from nonhumans, which is a truth that few biologists would deny. Nevertheless, there remains a core of similarities among all species in the modes in which they evolve and compete. Organisms all generally strive to survive and reproduce, in competition. Organisms frequently fail to survive and reproduce, which induces differential survival of attributes. To a large extent, specific behavioral and morphological characteristics of any species must accordingly reflect evolutionary processes. If we want a general framework for understanding behavior or any life process, we must begin at the roots of biological existence.

All of the data on human suicide should at some level of analysis fit within a biological perspective. I would argue that this perspective could give us a framework for developing a global, integrative hypothesis. I have deliberately focused here on the ultimate determination of suicide rather than its proximate causation, which may have led to some imbalance, but have used the wealth of data on proximate causes to derive the necessary inferences. The biological perspective proposed is not generally in opposition to the sociological, anthropological, psychodynamic, learning, cognitive, physiological, or behavioral genetic approaches to the phenomenon. Rather, it subsumes most of these approaches.

Imperfections in Biological Adaptation

There is a large degree of nonspecificity and error in human biological adaptation. Cultural, social, and technological transitions have been occurring at such a rapid rate that a substantial lag exists between them and biological evolution. We are not fully adapted to the modern circumstance. While in many respects coping has become easier than in previous history, as reflected by increased longevity (Acsádi & Nemesekéri, 1970; Retherford, 1975), a substantial minority in the population nonetheless fails to cope. A

variety of maladaptive, pathological conditions arise within many individuals from each generation because of ecological transitions and other reasons discussed in Chapter 7.

Individuals that fail to cope are those lacking the specific abilities or mechanisms that are necessary for fitness within their environment. Many individuals are not biologically prepared for the environmental contingencies with which they are presented and are consequently unable to achieve biological fitness. A biologically fit organism is one that is successful in reproduction. Nonreproducing individuals may also achieve fitness by engaging in productive activity favoring the reproduction of individuals sharing their genes. Despite the many special human attributes, there is no known reason why we should substantially differ from other species with respect to these definitions of fitness and successful coping.

Suicide is one of many unusual events and conditions that arise in times of coping failure. But it is most often not the coping failure itself (see Chapters 5 and 7). Rather, it usually occurs after some other coping failure has occurred. Accordingly, it is not entirely a maladaptive act in a biological sense in many of its instances. The coping failures associated with suicide may be diverse; the commonality among cases may lie in an inescapable loss in the ability to promote inclusive fitness. Suicide apparently occurs among those physiologically capable of surviving for some time, but who for social, behavioral, or physiological reasons are prevented from coping effectively.

There may also be a minority of cases where suicide is part of the pathology itself (see Chapters 7 and 12). In this minority, suicide may itself constitute a coping failure in that the act removes reproductive potential from the population. In these latter cases the act is truly maladaptive in a biological sense.

Coping Strategies and Life Events

Let us examine a human individual's general strategy for coping to see how this explains suicide. First and foremost, an individual strives to survive. Almost all children strive to survive; usually, genetically related adults do their utmost to engender these children's survival. Upon reaching adolescence, individuals begin to assume more independence and seek to engage in reproductive activities. The mating market is competitive, and some thrive within it while others fail. The economic-social market, through which individuals engage in productive activities with the end of facilitating their survival and reproduction, is also competitive. Some cope very well, most cope reasonably well, and some fail to cope in these markets.

Individuals failing in reproductive endeavors alone are not necessarily

precluded from behaving toward their inclusive fitness. They may become involved in some activity that promotes the general welfare of their reproducing kin or of proximate social groups to which they belong. In behaving toward the benefit of reproducing individuals sharing their genes, they are directly working toward inclusive fitness. Their continued existence is well justified by selective pressures, despite the fact that they may never be reproductively active. Such individuals may also hold out, as long as they are sexually capable and fertile, for a future day in which direct reproduction may be possible. A mating market may continue for females until menopause, and for males until very late age. But even individuals that are likely to be entirely excluded from reproduction may promote their inclusive fitness by working toward the benefit of reproducing relatives; their continued life should be favored by natural selection as long as they retain this capability.

By behaving toward the welfare of groupings larger than extended family, an individual may be promoting his or her genes' welfare in a very indirect manner. The extent to which such activity promotes such an individual's inclusive fitness may be greater with smaller groups containing more genetically related individuals. Membership in such groups may have been more prevalent in earlier human history. But the welfare of an individual's kin may often be contingent on the welfare of some larger society. As discussed in Chapter 9, the orientation of individuals' behavior toward the benefit of their larger social grouping may be more plausible in the human case than has been assumed by some behavioral ecologists. Usually, however, behavior oriented toward the benefit of the individual's culture may also be exchanged in a market for favors enhancing the individual's more direct capacities to promote his or her fitness. An individual's work may gain benefits facilitating reproduction and the capacity to improve the fitness of reproducing kin.

It is generally in the interest of any culture to encourage constituent individuals' continued existence if they are nonreproducing but productive. For these individuals, group-promoting behavior might indirectly act toward inclusive fitness, but the culture's long-held-out promises of improvements in more direct biological fitness might also encourage their continued existence. A culture can accordingly exert pressures that might modulate individuals' tendencies toward self-preservation.

Coping Failure and Suicide

Coping failure may occur progressively as more direct manners of promoting inclusive fitness are lost. The more capable an individual of propagating his or her genes, the more biologically fit he or she is. Effective coping may be rendered difficult by failure in direct reproductive activities, by the

loss of the capacity to behave toward the benefit of potentially reproducing kin, and by failure to achieve in productive enterprises. Different individuals may assume different strategies in promoting their inclusive fitness; the failure of one strategy without recourse to another may be especially damaging to fitness. Social isolation may be conducive to inability to promote fitness in several of the available manners. Various physiological debilitations may similarly impede several of these manners. Social rejection may suggest to individuals that they are counterproductive to their kin or social grouping, and may be especially damaging when they are without a direct capacity to reproduce.

All of the evidence suggests that the probability of suicide increases as the capacity to promote inclusive fitness diminishes (see Chapter 5). This relationship holds in a relative, rather than an absolute, manner. There is some error in the process; some suicides occur in potentially fit individuals. Also, many of the least fit individuals in the population never commit suicide.

If individuals are precluded from promoting their inclusive fitness, their continued life may not be justified by selective pressures. Life itself and life-promoting behavior are theoretically only favored by natural selection when direct or indirect reproductive potential exists. Non-life-preserving behavior and pathological physiological states may consequently arise when biological fitness becomes reduced, and suicide and other forms of death apparently occur in these circumstances (see Chapter 8).

Biological fitness varies within an individual's lifetime dependent on health and social circumstances. It generally may decline with age in many cultures, especially in postreproductive, postnurturance ages. The probability of suicide appears to be correlated with variation in biological fitness in a lifetime. Selective pressures will differentially affect an individual and the gene expression influencing physiological and behavior states dependent upon coping status. The probability of suicide and other non-life-preserving tendencies apparently increases as fitness is lost with aging or coping failures in youth.

Suicide is a unique form of death in that it is behaviorally self-induced. It may be most probable when effective coping is unlikely but where death does not immediately occur through other causes. There may also be interindividual variance in cognitive structure, affective structure, and experience that produces variance in the probability of suicide when fitness is low.

Mediation of Motivational Changes Accompanying Coping Failure

A variety of proximate factors apparently mediate a motivational change during coping failure from a life-preserving to a life-threatening orientation. I

have postulated that these mechanisms act synergistically to determine the probability of suicide.

Nonassociative Factors

There is growing evidence that various changes in neural transmission and hormonal state occur during severe stress or coping failure (see Chapter 10). Some evidence suggests that brain monoamine levels are depleted during protracted, inescapable stress, which may be associated with decreased general activity levels, negative affect or dysphoria, and decreased attempts at new coping activity. Failure in coping accordingly may be conducive to nonassociative physiological effects that change the structure of motivation. Pharmacologic studies clearly suggest that states of dysphoria are dependent in part upon nonassociative physiological conditions. In Chapters 4 and 8 it was also discussed how other non-life-preserving physiological states may be engendered by inescapable stress, as is evident for example in the sudden death phenomenon (see Hughes & Lynch, 1978; Richter, 1955, 1957). These physiological and motivational changes may have been long established in phylogeny, as is evident in their occurrence in a variety of species. Such nonassociative effects could conceivably contribute to the motivation of suicide, acting in concert with learned aspects of the behavior. Nonassociate motivational changes during stress may directly reflect changes in gene expression that would be predicted on the basis of selective pressures.

Cognition and Learning

Repeated failure in attempts to promote inclusive fitness may also alter cognition through learning experience. Prolonged coping failure is apparently conducive to cognitive states of hopelessness or desperation (see Beck, Kovacs, & Weissman, 1975; Farber, 1968; Seligman, 1975). It seems very likely that biological and cultural evolution have imparted to individuals some conception of life goals and interests. This general conception may pervade individuals' logic, such that they may generally learn behavioral patterns or initiate novel behavior that acts toward these interests. An individual experiencing coping failure may accordingly deduce that life serves no purpose because he or she is repeatedly thwarted in attempts to promote inclusive fitness. Also, because of sudden changes in coping status, as has occurred frequently in history when capture or slavery were impending or in modern circumstances involving major losses, an individual may envision unacceptable future conditions. In such circumstances individuals may be likely to imitate previous suicides that have occurred in their culture. As was argued in Chapter 6, suicide may have begun to occur as technological change and increased behavioral flexibility made the act conceivable; suicide may have dif-

fused through human culture through selective imitation by those experiencing intractable coping difficulties. Such a cultural process is not opposed by pressures of biological evolution, and hence may recur unimpeded by natural selection.

Social Factors

Although the predominant social attitude has in many cultures been antisuicide, even in such cultures some individuals may be made to feel unwanted or burdensome by a lack of social contact or negative social interactions. In other cultures the social pressures favoring suicide may have been more explicit, as for example among Eskimos (Leighton & Hughes, 1955) or in parts of the Orient (Iga & Tatai, 1975; Venkoba Rao, 1975). In the social conditions prevailing during most of human cultural evolution, the continued existence of individuals experiencing coping failure may have operated against their inclusive fitness. This would be true insofar as they were burdensome to kin or proximate social grouping. Hence, prosuicidal motivational factors may have had adaptive value if they occurred among those unable to cope. Indeed, there is a substantial amount of evidence, reviewed in Chapter 9, that guilt, shame, social rejection, and transgression of social mores are involved in the etiology of many suicides. Because individuals may have long been structured such that they behave toward the benefit of those sharing their genes, they may conceive suicidal acts when they view their continued existence as harmful to kin and proximate social grouping. In the modern social context, where individuals often have little contact with kin and may belong only to very large social groupings, psychic factors shaped in previous evolutionary history may induce suicide in somewhat novel social contexts that resemble those prevailing earlier in human evolution.

It seems likely, then, that a variety of factors have synergistically produced the phenomenon of suicide and determined its social ecology. There are, of course, individual differences in the balance of specific etiological factors. There are similarly individual differences in the propensity to engage in suicidal acts when suffering coping difficulties; these differences presumably relate to differences in affective structure and learning experience. It is remarkable how well the social ecology of suicide conforms to pressures of natural selection; suicide is not entirely divorced from the predominant fitness orientation of behavior. However, as discussed in Chapters 5, 7, and 12, some truly maladaptive suicides may occur due to ecologically novel conditions.

14

Parasuicide and Suicide

A consideration of a single human behavioral phenomenon in total isolation from potentially related behavioral phenomena is likely to be somewhat artificial and incomplete. As was briefly discussed in Chapter 2, parasuicide or attempted suicide may occur at an appreciably higher rate than does suicide. Given that parasuicidal acts may either involve true but failed attempts at suicide or a mimicry of the act of suicide, they should be given some consideration here. The determination of suicide, as I have discussed it to this point, appears to be multifarious, involving a synergy of a large number of factors. Different factors may act as principal causes in different cases, but in almost any case there are probably several secondary determinants. It seems likely that several diverse factors influence the frequency of suicide in a culture, and the nature of a closely related phenomenon, as is parasuicide, may also play some role in determining the nature of suicide itself.

My discussion of parasuicide will be brief, being limited to a consideration of how the act relates to suicide itself. This volume is primarily concerned with behavior that is truly of a self-damaging nature. Completed suicide is unequivocally damaging to an individual's continued existence, but parasuicide is not clearly so, and indeed may be oriented toward benefits the individual survives to appreciate. Stengel (1973) and Kreitman (1977) have forcefully argued that many survived suicide attempts are deliberately survived, and that those committing such acts anticipate that they will be rewarded for this behavior by increased attention from others. Such an act is an albeit desperate attempt to gain benefits that directly improve the individual's fitness. As such it is more clearly in tune with the normal orientation of behavior than is suicide. Parasuicides consequently do not merit the same degree of attention for the analysis undertaken in this volume.

It is likely, of course, that some serious suicide attempts will inadvertently fail, whereas some intended suicides will inadvertently lead to death. This in one sense introduces some error into data on both phenomena. It also suggests another possible determinant of suicide, and one which may help to account for some of the cases in which suicide occurs where it clearly harms the individual's inclusive fitness.

Definitions of Parasuicide and Biases in Data

The definitions of parasuicide and attempted suicide seem to vary considerably among different researchers in a manner that introduces problems into the comparability of the data. Generally, these definitions subsume a range of phenomena involving discrete nonfatal assaults by individuals on their physiological integrity. These acts are of an apparently life-threatening nature but are survived. Kreitman (1977), who derives much of his data from admissions to a poison treatment center, defines parasuicide as "a non-fatal act in which an individual deliberately causes self-injury or ingests a substance in excess of any prescribed or generally recognized therapeutic dosage [p. 3]." He adds three other criteria to be used in identifying parasuicides:

1. The investigator must rule out the possibility that the act is accidental.
2. Alcohol intoxication is omitted because there is no commonly recognized proper dosage.
3. Toxic reactions in drug addicts are excluded because the intent to die is absent.

Stengel (1973) speaks of a commonly adopted definition of attempted suicide: "a deliberate act of self-damage which the person committing the act could not be sure to survive [p. 83]." These definitions differ on a critical dimension; Stengel's entails a risk of death while Kreitman's does not. Stengel also says that he excludes apparently harmless and trivial cases while Kreitman does not expressly do so. For example, Kreitman derives some of his data from questionnaires sent to local medical practitioners, in which they are asked to report all cases of poisoning and deliberate self-injury in persons 15 years of age and older, without any specification of the degree of seriousness.

The data on parasuicide and attempted suicide, unlike those on completed suicide, are derived almost exclusively from psychiatric reports and hospital emergency admissions. Data on suicide generally come from coroners' reports, and large samples have been analyzed on an epidemiologic level by sociologists and other researchers. With notable exceptions such as

Kreitman and associates' ongoing research in Edinburgh, large samples of parasuicides are infrequently analyzed, having received little attention from sociologists. There are numerous studies in the psychiatric literature involving small sample sizes, and it is difficult to gain a broad perspective from these given differences in definition, reporting styles, and focuses.

Several other sources of bias affect the data. Many of these biases derive from the fact that psychiatric consultations and hospital admissions are the main sources of information. Those not referring to psychiatrists due to financial constraints or other reasons may be excluded from the sampling, and many less serious cases may not show up in hospital records. Even many more serious cases of acts such as self-poisoning may not be referred to hospitals when individuals find ways to cope with the event on their own. Others presenting themselves to hospitals may have committed acts of parasuicide but not be recognized as such. A judgment is in any event required on the part of those attending to possible cases of parasuicide; different individuals are likely to use different criteria in their judgments. Also, many true cases of parasuicide may be covered up to avoid public embarassment, with some collusion on the part of medical personnel; Stengel (1973) has suggested that this may particularly occur in suicide attempts in upper social classes.

As was discussed in Chapter 2, estimates from studies in Great Britain and the United States indicate that the number of suicide attempts or parasuicides is in the order of 6-10 times the number of suicides (Kreitman, 1977; Stengel, 1973; Stengel & Cook, 1958). This does not, of course, mean that there are that many more individuals attempting suicide than committing successful suicide; suicide can be completed only once by an individual whereas the same individual can perform several acts of parasuicide. As will be discussed below, there are some data on the frequency of new parasuicidal acts and suicides among previous attempters, but these data are not sufficiently thorough to support strong conclusions. Unfortunately, the fact that data on suicide and parasuicide are drawn from different sources with different sets of biases, as well as the incomplete nature of most follow-up studies of parasuicides, makes an accurate estimate of their relative incidence elusive.

Social Ecology of Parasuicide

As was discussed briefly in Chapter 2, the social ecology of parasuicide differs substantially from that of suicide. Apparently, the sex ratio for parasuicide is opposite to that for suicide, with many more women than men committing parasuicidal acts (Kreitman, 1977; Parkin & Stengel, 1965; Stengel & Cook, 1958). Also, the peak rates for parasuicide are in young

adulthood, with relatively low rates among the elderly (Kreitman, 1977; Parkin & Stengel, 1965), whereas suicide frequency generally increases as a function of age. Results of a study by Pederson, Awad, and Kindler (1973) from hospital admissions in Monroe County, New York, over a 3-year period are given in Table 14.1. Unfortunately, this does not give rates adjusted for the age, sex, and race composition of the local population. However, it does support assertions that female parasuicides are more common than male parasuicides and that the peak age range is between adolescence and mid-adulthood. It also suggests that the racial composition of parasuicidal acts is strikingly different from that of suicidal acts, with a high frequency of parasuicide among nonwhite young females. Pederson *et al.* did give estimates of population adjusted rates of 160 per 100,000 population per year for nonwhites and 53 per 100,000 population per year among whites, with a sex ratio of 1:6 for nonwhites and 1:3 for whites. This again supports the conclusion that parasuicide is of a substantially different nature from suicide.

Steele (1977) has similarly suggested that the frequency of suicide attempts among American blacks is as high as that among whites, based upon a study of hospital admissions from 1971-1972 in New Haven, Connecticut. Steele has used these data to suggest that the psychology of blacks is similar to that of whites, at least with respect to parasuicidal acts. However, Bedrosian and Beck (1978) have examined Steele's data further, suggesting that this conclusion might be premature. Bedrosian and Beck argued that white suicide attempters score higher on scales of hopelessness and depression than do black suicide attempters, suggesting that the psychology of the act in the two racial groups might be quite different.

Parkin (1974) has examined 203 cases of hospital admissions for attempted suicide in Fairbanks, Alaska in the period from 1960-1971. He

Table 14.1
Numbers of Hospital Admissions for Parasuicidal Acts by Age, Race, and Sex in Monroe County, New York, 1964-1967 [a]

	White		Nonwhite	
Age-group	Male	Female	Male	Female
0-14	1	2	10	5
15-24	90	238	153	803
24-44	49	129	67	436
45-64	21	44	0	87
65+	18	13	0	62

[a] Source: Pederson, A. M., Awad, G. A., & Kindler, A. R. *The American Journal of Psychiatry*, October 1973, *130*, 1071-1076. Copyright 1973, the American Psychiatric Association. Reprinted by permission.

compared the incidence of these acts in three cultural groups: nonnatives, Athabaskans, and Eskimos. The largest number of attempts occurred in white females, with female attempts generally being more serious or life-threatening than male attempts. There was a steady increase in the number of attempts among natives over this period, but Parkin argues that this may be due to an influx of natives into the city. Parkin indicates that most of the cases of parasuicide among natives involved those from broken homes and with little education. He pointed to extreme stresses involved in cultural transition in these cases. He also suggested that native women tended to employ methods that were obviously of an attention-seeking nature.

The literature seems to indicate that coping difficulties are almost universally antecedents of parasuicidal acts, much as they are of acts of suicide. Indeed, Stengel (1973) suggests that the "motives and causes underlying suicidal attempts are in essence the same as those of suicide, although they may appear different if the attempt to impress or hurt other people is more conspicuous than the urge to self-destruction [p. 113]." Kreitman (1977) indicates that parasuicide is common among the divorced, the overcrowded, and those from lower socioeconomic classes. Other factors that he reports to be correlated with parasuicide are unemployment, criminal offenses, physical illnesses, juvenile delinquency, eviction from the home, rent arrears, and mortality of infants. Paerregaard (1975) similarly points to physical disabilities and criminal problems as correlates of parasuicide. Breed (1967) suggests that marital difficulties and other problems with members of the opposite sex are the most frequent factors related to suicide attempts in women, while loss of position or job is the most frequent factor in men.

Due to the fact that this phenomenon is most commonly studied by psychiatrists, much attention has been given to psychiatrically defined mental disorders in cases of parasuicide. Stengel (1973) cited two samples of psychiatric classifications of individuals attempting suicide. In the first, derived from data in 1946 from hospital admissions, 13 cases were related to schizophrenia, 49 to depressive illness, 45 to other abnormal depression, 21 to psychopathic personalities, and 10 were classified as "other." The second, smaller sample showed a similar configuration. Insufficient information was given to assess the reliability of these diagnoses. Another such study was that of Batchelor and Napier (1953), who contended that all 40 of their sample of attempters over age 60 showed recognizable psychiatric illness, with two-thirds being labeled as psychotic. Of the total, 80% were said to show depressive illness and 10% organic brain syndrome. The usefulness of such statistics for our purposes may be questionable due to value judgments and unreliability involved in such diagnoses (see Chapter 7), although the data do confirm that depressive states relate to parasuicide. Kreitman and coworkers (1977) conducted various personality tests on samples of individuals

committing parasuicidal acts. In one sample of 100 patients using the Sign Symptom Inventory, a greater number of "character disorders" was found among those committing parasuicidal acts than among controls who were medical or surgical patients. Again, the disordered nature of character involves a value judgment, although it may suggest coping difficulties among the parasuicidal. Kreitman (1977) also reported that, in a 12-month follow-up of about 2800 cases, previous psychiatric treatment was prevalent, as were problems involving unemployment, criminal infractions, the use of alcohol and drugs, and low socioeconomic status. There are numerous other reports in the psychiatric literature similarly relating suicide attempts to psychiatric disturbances.

It is probably fair to conclude that parasuicidal acts generally occur in those with coping problems, and that states of depression are also frequently related. The coping difficulties may be of a diverse nature, and in this sense parasuicide is very similar to completed suicide. However, at least some parasuicides involve an attempt to manipulate the behavior of others. Stengel (1973) argues that many of those attempting suicide deliberately undertake nonlethal acts, constructing the situation such that others are likely to intervene in time to prevent death, or calculating a dose of a drug or poison that could not be lethal, or by simply faking the act. Shneidman (1966) similarly speaks of "contraintentioned" acts, where an individual has every intention of surviving a parasuicidal act. The marked differences in age and sex distribution of parasuicides and suicides underscore the fact that the two behavior patterns may be quite distinct.

Although parasuicidal individuals may generally be experiencing coping difficulties, it is questionable whether these are of the severity of those involved in true suicide. This would especially be true of cases that are intended to manipulate others. The fact that an individual has contact with others who may respond to the parasuicide suggests that some potential for an improvement in coping status exists.

However, many parasuicides, especially those with some risk of death, may involve unresolved motives or be designed to test the individual's social environment. The severity of coping difficulties experienced by individuals surely lies on a continuum. Many of those committing parasuicidal acts are experiencing difficulties that if exacerbated might be conducive to true suicide. An individual whose coping problems stem from social situations might learn from his or her parasuicide how severe these problems are. The response of others to the parasuicide could be favorable or unfavorable to the individual's fitness; the test of others may accordingly change the individual's degree of suicidal intent by indicating to the individual his or her true coping status. This is especially true where individuals' coping status is contingent on their relationship to others, as it may be in many cases of relationships be-

tween the sexes, which directly determine reproductive status. People may also place themselves at the mercy of others in many suicide attempts, as does the individual who arranges that another person of significance will arrive shortly after a drug overdose is ingested. The other individual has the choice of coming to the rescue or being an accomplice in the suicide. The choice would be indicative of the strength of the relationship, and hence life or death may hinge upon the parasuicidal individual's actual coping status. It thus may be unwise to overemphasize the differences between determinants of parasuicide and suicide. An approach based on a continuum of intent, like that of Lester (1970) and Worden (1976), may be more accurate. Even a continuum may oversimplify the causation of suicide and parasuicide, in that this causation would seem to be multifactorial, with different synergies of factors involved in each case.

Follow-up Studies of Parasuicides

Another way in which to assess the relationship of parasuicide and suicide is to examine how many of those making unsuccessful suicide attempts ultimately complete suicide. Kreitman (1977) reports follow-up data for a 12-month period following parasuicide for large samples from five different years. About 17% of individuals from these samples engaged in new parasuicidal acts during this period, whereas only 1% completed suicide. A 3-year follow-up of parasuicides from 1 year found that 3.3% completed suicide during this period. A better perspective would be obtained from an examination of suicide completion rates within a longer term, but such studies are hampered by difficulties in tracing individuals years after an attempt. Schneider (1954) found that within 18 years of an unsuccessful suicide attempt, 11.8% committed suicide. Dahlgren (1977), working with 229 cases of parasuicide occurring between 1933 and 1942 in Malmo, Sweden, was able to trace the individuals for an average of 35 years. Of male cases, 96.8% were traced, whereas 95.6% of females could be traced. It was found that in the first 12 years, 9.7% of males and 3.7% of females committed suicide. After 35 years, 10.9% of the total male and female cases had completed suicide. Dahlgren felt that the critical period for risk of suicide was during the first 5 years after an unsuccessful attempt.

Tefft, Pederson, and Babigian (1977) conducted an interesting and thorough follow-up study of suicide attempts in Monroe County, New York. This epidemiological study compared patterns of mortality for a population of suicide attempters, a psychiatric population without suicide attempts, and a general population without psychiatric histories. Mortality patterns were investigated over an 11-year period in terms of demographic characteristics

and rates of death by various causes. Suicidal deaths were given special attention. From early adulthood until age 54, the suicide attempter group showed the highest mortality due to all causes, with the psychiatric population showing the second highest mortality rate. After this age, however, the suicide attempters had the lowest age-specific mortality. Suicide was by far the leading cause of death through age 44 for the suicide attempter group, among the three leading causes of death in later life, and the leading cause of death for that group overall. The profile for causes of death for the psychiatric nonattempter population was very similar to that for the general population; although suicide was more common in the psychiatric than in the general population (33.4 versus 6.7 per 100,000 population per year), it was in either case much lower than in the suicide attempter group (rate of 119.9). The mortality patterns among suicide attempters differed in other manners from those of the other populations; they showed the lowest overall mortality, which may have related to their lower average age, but the highest age-specific mortality in the 15- to 54-year age-range, largely due to suicide and other nondisease conditions. Tefft *et al.* concluded that suicide attempters account for much of the increased suicide risk reported for psychiatric populations.

In summary, suicide is more probable among those that have committed parasuicidal acts than in the general population. However, the majority of those committing parasuicidal acts do not subsequently commit suicide. For example, the data of Tefft and co-workers indicate that suicide accounted for about 29% of deaths among attempters, which is substantial but by no means a majority. Also, Tefft *et al.* indicated that the majority of all suicides in Monroe County during their 11-year study period were committed by persons without a recorded history of suicide attempts. There seems to be substantial overlap between the populations of suicide and parasuicide, but a large degree of independence of the two phenomena as well.

Lethality of the Suicide Attempt

Another perspective on the relationship of suicide and attempted suicide comes from studies comparing the characteristics of those employing methods with high or low risks of death. Dorpat and Boswell (1963) evaluated the degree of suicide intent in 121 attempts, rating these on a 1-5 scale from nonserious suicidal gestures to serious attempts. Low-intent individuals were characterized as attempting to manipulate others. High-intent individuals generally included males, older individuals, and those diagnosed as psychotic. The ambivalent or medium-intent cases were characterized as individuals attempting to test the affection and care of others. Rosen (1970)

examined a sample of 886 attempters, classifying 21% as serious and 79% nonserious, proportions that roughly correspond to some of the figures cited above for the proportion of attempters that ultimately commit suicide.

Green and Lee (1967) examined the lethality of attempts and related this to long-term suicidal risk. Contrary to expectation, the long-term risk in patients who made potentially lethal attempts appeared to be no higher than that reported among attempted suicides in general. They suggest that the degree of medical danger in an attempt is not a reliable indicator of risk.

A study by Worden (1976) looked at the personal and social characteristics of 40 suicide attempts, relating this to a quantitative assessment of severity in the suicide attempt. Several characteristics were found to discriminate significantly among high-lethality and low-lethality attempters. High-lethality attempts were associated with persons who had expected serious injury or death from the attempt. These persons had few friends and showed a lifelong difficulty in interpersonal relationships. A history of psychiatric illness was also more common in the high-lethality group. In contrast, the low-lethality cases were associated with relatively good social relationships. This is similar to a report by Jan-Tausch (1963) that the major difference between suicide attempters and successful suicides was that the latter had much greater difficulties in social relationships.

In summary, there is some indication that the characteristics of those committing parasuicidal acts with greater risk of death are more similar to those of true suicides than are the characteristics of low-risk parasuicides. However, it is unclear whether high-risk attempters are ultimately more likely to commit suicide. Clearly, more research of this nature, examining larger samples of parasuicides, is needed.

Conclusions

From this brief review it is clear that there is a substantial amount of variance in the situations of those committing parasuicidal acts. There appear to be many cases where the intent to complete suicide is very low. These cases involve a mimicry of the act of suicide, apparently with the intent to gain social benefits through survival of the act. Such low-intent or contraintentioned acts are clearly not self-destructive in nature and the social characteristics of those committing them differ markedly from those of suicides. On the other hand, there are cases of parasuicide where the individual's conscious intentions are not clear and/or where the risk of death may indeed be high. Many of these latter cases may be quite similar to true suicide in terms of the social characteristics of those committing the act.

Cases that simply involve a mimicry of suicide to gain ends in life seem to

involve an epiphenomenon that is not truly a form of self-destructiveness. Such acts gain their effect because suicide truly occurs in other individuals; the bluff behind such threats would always be recognized if suicide were never carried through. Individuals, having some knowledge of the occurrence of true suicide in their culture, may conceive of acts of parasuicide as strategies to promote their inclusive fitness. Such parasuicide may also relate to suicide as threat gestures relate to aggression in many species; the threat may forestall the occasion for the more dramatic act with less cost to the individual. Parasuicide may also act like an intention movement; the gesture carries communicative value that may test the behavior of others and inform them of the potential consequences of their actions.

One remote possibility is that suicide is in part determined by the fact that it legitimizes the manipulative power of parasuicide. The clear gains in fitness that may accrue from social rewards following parasuicide would not occur if no individual ever carried through his threat. It is difficult, however, to conceive of how this could align with selective pressures; individuals committing suicide to give force to their bluffs do not survive to appreciate this benefit. Such individuals would also be unlikely to benefit from any force they gave to threats of others. Through purely cultural means and aberrant logic in some individuals, such a determination of suicide might be conceivable; in some cases individuals may view their completed suicide as punishing or otherwise manipulating others. However, it is difficult to see how this could be involved in even a substantial minority of suicides, especially given evidence cited above that most individuals completing suicide have not previously committed parasuicide. It is much more likely that parasuicide is a phenomenon that is secondary to suicide than is the reverse relationship.

Cases of high-lethality attempts or ambivalent intent would seem to extend our estimates of the incidence of self-destructiveness in the human population. These cases may more closely relate to suicide itself, since they seem to occur in those in similar social-ecological positions. Adding these cases to cases of completed suicide yields a higher total proportion of the population engaging in potentially self-destructive acts.

15

Chronic Self-Abuse, Risk Taking, and Other Self-Damaging Behavior

I would like very briefly to survey the range of other self-damaging behavior patterns that are prevalent in modern human populations. The chapter will begin with chronic self-abuse, especially involving alcohol and drugs, and subsequently consider a variety of other modern patterns. This will undoubtedly do little justice to the complexity of these topics. The purpose here is twofold. First, I would like to examine whether there is some degree of commonality of determination of suicide and other self-damaging behavior. Second, I would like to outline briefly possible manners in which sociobiological theory and research may contribute to the understanding of these topics.

Chronic Self-Abuse

Many of the foods and drugs available in modern cultures constitute novel ecological conditions. Many of them have been available to large portions of the population for only a very brief period within an evolutionary time scale. Consequently, there has been an inadequate number of generations for natural selection to produce adaptation. Again, cultural change has occurred ahead of biological change, introducing new selection factors. Behavior in the presence of novel contingencies is likely to be unpredictable and in many cases predictably maladaptive.

Alcoholism

Alcoholic beverages have been ingested in many human cultures for numerous generations. Among Caucasian cultures, alcohol has been a well-

entrenched part of the diet at least since Biblical times. Its psychoactive effect seems to derive from its production of a general, nonselective, reversible depression of central nervous system activity (Julien, 1978). Alcohol is consumed by the vast majority of individuals in many parts of the world, and it is questionable whether moderate usage produces much physiological or psychological harm. Nutritionally, the only established value of alcohol is caloric. When used in small amounts, its status as food as opposed to drug is primarily a question of semantics.

Yet, many individuals consume doses of alcohol that are well in excess of the mean dose for the population, and in so doing may decrease their longevity. Evidence is mounting that excessive alcohol consumption is associated with early death from several cases, including diseases of the heart and liver, pneumonia, cancer of the lung, throat, gullet, and mouth, acute alcoholic poisoning, accidents, and suicide (Mellor, 1975; *Mortality from Alcoholism*, 1977). Most of such adverse effects increase directly as a function of the amount consumed. The Ontario Addiction Research Foundation has defined a level of physically hazardous alcohol consumption as any level exceeding an average of 15 centiliters of absolute alcohol per day (*Facts about Alcohol*, 1975). Others employ a more flexible definition of alcoholism, derived from the World Health Organization approach, as consumption involving dependency leading to a noticeable disturbance in mental health, bodily health, or economic functioning (Smart, Gillis, Brown, & Blair, 1978). Under any definition, alcoholism clearly is a widespread and life-threatening phenomenon. One estimate of its frequency in the state of Maryland gave figures of 433 per 100,000 white male adults, 99 per 100,000 white female adults, 656 per 100,000 nonwhite male adults, and 219 per 100,000 nonwhite female adults (Gorwitz, Bahn, Warthen, & Cooper, 1970). Such a sex composition is typical; alcoholism is far more prevalent in men than in women, although the ratio varies among societies (Becker & Kronus, 1977; Cosper & Mozersky, 1968; Keller & Efron, 1955; Mellor, 1975; Popham, 1959). The similarity of this ratio to that characterizing suicide is notable and consistent with generally higher rates of both behavioral and physiological disorders in men. The relationship of alcoholism and age may differ from that of suicide and age; a number of studies suggest that peak prevalence for almost all types of drinking problems is in the twenties or mid-adulthood (e.g., Bronetto & Moreau, 1964; Cahalan, 1976; Cosper & Mozersky, 1968; Encel, Kotowicz, & Resler, 1972; Ferreira, 1976; Knupfer & Room, 1964), although this depends on the culture under consideration. This relationship is, of course, affected by differential mortality of alcohol abusers and nonabusers. Findings related to socioeconomic status are varied; the lowest prevalence seems to be in the middle socioeconomic groups (Mellor, 1975).

Clinical studies invariably report a high proportion of unmarried alcoholics, with divorced, separated, or never married individuals showing markedly higher rates than married individuals (Bacon, 1944-1945; Bronetto & Moreau, 1964; Cahalan, 1976; Cosper & Mozersky, 1968; Knupfer, 1965; Mellor, 1975; Tahka, 1966; Walsh, 1968). The order of causation underlying this relationship is difficult to determine. Those with marital difficulties or problems in forming relationships with members of the opposite sex may on the one hand be more inclined to drink excessively. On the other hand, those with alcohol problems may have difficulty forming and maintaining reproductive relationships. Some data are available on this issue. Paolino, McCrady, and Diamond (1978) found that alcoholics are as likely to marry as anyone but are at least four times as likely to separate or divorce. Horn and Wanberg (1970) report that recent marriage difficulties are common in alcoholics, that few children are present if the individual has been married, and that long-established marital and family difficulties and social isolation are common among alcoholics. These factors are quite similar to those related to suicide (see Chapter 5), but the causation underlying these relationships remains unclear. A major question for future research is whether the relationship of coping difficulties and reduced reproductive opportunities to alcoholism is homologous to the relationship of similar factors to suicide.

There is evidence in the literature that alcohol consumption is increased by recent hardship, much as is the probability of suicide. Pearlin and Radabaugh (1976) report relationships of alcohol consumption to economic problems, anxiety, and low self-esteem. Roman (1978) speaks of a strong predisposition of many individuals to use alcohol to control distress. Roman argues that this can lead to greater anxiety and even lower self-esteem, which in turn may add to distress and lead to further drinking. Browne-Mayers, Seelye, and Sillman (1976) have related alcoholism in a sample of older women to factors of stress, finding that almost all had experienced some type of family stress, marital disharmony, sexual conflict, isolation, job-related stress, difficulties in parenting, and/or physical or psychiatric illness.

It is well established that suicide and parasuicide rates are much higher in alcoholics than in abstainers and light drinkers. Both suicidal attempts and actual suicides seem to be more frequent among alcoholics than in the general population (Hart & Keidel, 1979; Morrison & Pendery, 1974; Tahka, 1966). Suicides and suicide attempts are commonly committed under the influence of alcohol (Tahka, 1966). Hart and Keidel (1979) report that alcoholism is one of the most distinctive features of adolescents' susceptibility to suicide. Morrison and Pendery (1974) note that suicidal behavior may occur during alcoholic blackouts.

It would be very premature to draw any strong conclusions about the rela-

tionship between suicide and chronic self-abuse through alcohol overconsumption. There are, as reviewed above, similarities in social ecology. Particularly, there are signs that those drinking to excess are often those who have experienced coping difficulties; alcoholism may be potentiated by chronic coping problems. Hence, as with suicide, there is an orientation of behavior away from a self-preserving pattern and toward a self-damaging pattern subsequent to coping difficulty. Some underlying factor may accordingly be common to some cases of alcoholism and suicide. However, alcoholism is exceedingly complex in determination, and there are several other factors that play major roles in its etiology. Apart from its caloric value, it may indeed bring some benefits to those employing it, including, perhaps, some mild and temporary relief from stress. Some such benefits must be reinforcing its widespread moderate usage.

It is probable that, in cultures where it has long been consumed, alcohol brings both benefits and costs, and that the costs reflect imperfections in adaptation. Some of these costs, insofar as they occur among those with already reduced biological fitness, may not be readily affected by selective pressures for reasons discussed in Chapter 8. However, the costs are clear if the alcohol abuse is itself conducive to a reduction in biological fitness. The benefits of moderate alcohol usage for most adults may favor its continued consumption, but carry the by-product of alcohol abuse by a minority. If this is true, some adaptation of the culture to the presence of alcohol has occurred, but such adaptation may as yet be insufficiently precise to prevent the negative by-product. The number of generations of exposure to alcohol may have been insufficient for a total adaptation.

One important consideration is that, although wine and other moderately alcoholic beverages have been consumed throughout recorded human history, distilled spirits have only been in wide use since the eighteenth century. It is well known that during that century, alcohol-related disorders were widespread in Europe. Interestingly, the modern costs of alcohol consumption may be greatest in populations previously not adapted to the ready availability of this substance. This is particularly evident in the alcohol problems of Amerindians, who may have for centuries before European influence had little exposure to alcoholic beverages. This is another example of how ecologically novel conditions are conducive to maladaptive behavior (see Chapter 7).

Tobacco and Nicotine

Tobacco was long used by some Amerindians, but its use in other populations in the world is of recent origin. Nicotine is believed by many pharmacologists to act upon the cholinergic neurotransmitter system (Julien,

1978). Cholinergic neurons are known to occur in the autonomic nervous system, especially parasympathetic portions, and also in the central nervous system (Carlson, 1977; Cooper, Bloom, & Roth, 1974; Iverson & Iverson, 1975; Julien, 1978). Some cholinergic neurons are of a muscarinic variety, responding to the drug muscarine; others are of the nicotinic variety, responding to nicotine. It is also known that the cholinergic system is involved in restorative functions after stress (Anisman, 1978; Carlton, 1969). It is conceivable that self-administration of nicotine facilitates the adaptation of some individuals because it helps them to cope with stress; it may induce chemical equilibrium in the nervous system in times of stress. Schacter's (1977) research has shown that people smoke tobacco for the nicotine, and that stress increases smoking.

Medical evidence is increasingly indicating that the long-term effect of tobacco smoking is a reduction in longevity. Premature death may occur due to lung cancer, emphysema, other lung maladies, and coronary disease (Julien, 1978). Clearly, any short-term benefit carries a long-term cost. Whether its short-term effect is also in some respects adverse is not certain, although it potentially reduces oxygen availability to all bodily tissues, through its effects on hemoglobin, and increasing evidence indicates that it is both teratogenic and mutagenic (Julien, 1978). It furthermore creates dependency which may introduce a motivation that competes with more adaptive forms of behavior.

There is undoubtedly variance in the population in the adverse effects of tobacco smoking, and it is conceivable that nicotine self-administration could have beneficial effects for some members of the population. There may also be some tolerance to smoke from burning organic matter that would have been engendered by humankind's longstanding burning of wood and organic matter for cooking and warmth. However, the fact that tobacco smoking has itself only occurred in most human cultures for a small number of generations may readily explain its adverse effects. It is interesting in this context to recall the alarm with which tobacco smoking was greeted when it first spread in Europe, as was reflected in the treatise of King James I of England on the subject. Tobacco remains a novel substance in human ecology.

Cannabis

Cannabis smoking has long occurred in some cultures, but its use has recently spread to large sectors of the population that previously have not been exposed to it. There is increasing knowledge on its chemical composition, and at least one active ingredient, tetrahydrocannabinol, has been identified (Julien, 1978). It probably shares many of the tolerances allowing tobacco usage and many of the adverse effects as well. Little is known about

its pharmacologic action and less about how this action relates to human motivation. As another environmental novelty it is likely to have adverse effects, many of which could depend on genotype. But, as with nicotine, positive benefits for a minority in the population are conceivable, and there is undoubtedly variance among individuals in susceptibility to both adverse and beneficial effects.

Other Drug Abuse

Many other drugs of abuse have similarly been present for only very brief periods in an evolutionary time scale. Frye (1980) discusses how drug abuse may relate to a lag between cultural and biological conditions. We are not biologically prepared to deal adaptively with drugs that have been available only in modern times. Accordingly, it is not surprising that the behavior of many individuals in the presence of such drugs is maladaptive. Again, it is clear that behavior will be either unpredictable or predictably maladaptive when it occurs outside of its natural ecology.

That does not necessarily suggest that usage of novel drugs will in all instances be associated with pathological conditions. Used judiciously, especially in knowledge of scientific information on dosage effects and toxicity levels, it is possible that usage of many drugs could be adaptive. Drugs provide a means of manipulating physiological and psychological conditions which may be of benefit for a variety of purposes. Even self-administered drugs may allow an individual to achieve self-control in manners that facilitate adaptation. Often, however, drugs allow a short-term gain at a long-term cost; individuals may suit their behavior to the short-term contingencies but fail to be influenced by the long-term aversive contingencies (Julien, 1978; Lettieri, 1978). Also, herbs, spices, and other plant derivatives have long been sought out and ingested by human beings. Such substances as tea, coffee, chocolate, nutmeg, tobacco, cannabis, opium, coca leaves, peyote, and qat have all been demonstrated to have psychoactive properties. In a sense, all of these are an extension of diet; we must not dismiss the possibility that they serve some nutritional purpose for some users. The adverseness of their effects may depend on genetics, environmental circumstances, and the number of generations in a culture that have been exposed to them.

There is evidence that other mammals will self-administer most of the drugs that humans self-administer (Iverson & Iverson, 1975; Julien, 1978; Schuster & Johanson, 1974). Many of these drugs are known to act upon specific biochemical systems that influence emotional and behavioral states. Catecholamine stimulants, such as amphetamine, cocaine, and apomorphine, are self-administered by both animals in experimental situations and man (Julien, 1978; Schuster & Johanson, 1974). Such stimulants affect

systems that are believed to be involved in both affect and reinforcement mechanisms in the brain (see Chapter 10). Opioids, such as morphine, will be self-administered by both humans and nonhuman mammals (Julien, 1978); such substances are now believed to act on endorphin sites in the brain (Barchas, Akil, Elliott, Holman, and Watson, 1978; Goldstein, 1978). Increasingly, brain mechanisms involved in other self-administered drugs, such as caffeine, nicotine, alcohol, and barbituates, are being identified (Julien, 1978). In many cases, animals and humans administering such drugs develop some tolerance to their presence, which evidently relates in part to the development of enzymes in the liver, brain, and other organs which improve the capacity to cope with these drugs and increase the speed of excretion (Julien, 1978). Behavioral and physiological dependence also commonly occurs, and coping difficulties may arise through withdrawal as much as through the ingestion itself (Julien, 1978; Schuster & Johanson, 1974).

The social ecology of drug abuse is not well studied, but might provide some insights for a sociobiological analysis. Conceivably, as with alcoholism, some individuals may be led to drug usage because of various stressful experiences. An individual may be more inclined to engage in abuse of drugs that are well known to have adverse health effects when it is believed that there is relatively little to lose; by contrast, an individual without coping problems may avoid drug abuse because of awareness that this may reduce fitness. On such a cognitive level, drug abuse may share antecedents with suicide. There is evidence that suicide and parasuicide are more common among drug abusers (Harris, Linn, & Hunter, 1979). Several different causative relationships could conceivably underlie a correlation of drug abuse and suicide: for example, both behaviors could be induced by coping difficulties, suicide could relate to coping difficulties brought on by drug abuse, both could reflect some pathological condition, and so on.

Lettieri and co-workers (1978) have given a detailed study and analysis of the relationship of suicide and drug abuse. They have wisely focused on the notion of coping strategies as they relate to suicide and drug abuse, without however discussing coping status within a biological framework. Suicide and drug abuse are viewed as arising when other coping strategies fail, which is in agreement with the discussion of suicide in previous chapters here. Within the volume edited by Lettieri, the relationship of drug abuse and suicide is addressed at length by Inciardi, McBride, and Pottieger (1978). Inciardi *et al.* review the theoretical notion that these behavioral patterns have an underlying commonality of causation, a notion that was especially advanced by Menninger (1938). Inciardi *et al.* also review competing notions that drug abuse may itself lead to problems conducive to suicide, as might coping difficulty consequent to addiction and drug toxicity. They suggest that research has indicated that:

1. Alcoholics have higher rates of suicide than the general population.
2. A history of suicide attempts is not uncommon among narcotics addicts.
3. Certain personality similarities exist between drug abusers and suicide attempters.

From a study of drug abuse in Dade County, Florida, Inciardi *et al.* (1978) conclude that drug abuse cases are predominantly male, with narcotics deaths being prominent among younger men and alcohol deaths prominent among men in the 35-50 age category. They compare this to the fact that many males tend to choose violent means of suicide. A large number of women in this sample used sedatives and tranquilizers in suicide attempts, but Inciardi *et al.* view this as a somewhat separate phenomenon from chronic narcotic abuse. Inciardi *et al.* view both chronic drug abuse and drug use in suicide as "gambles with death."

Also, in the volume edited by Lettieri, Kaplan (1978) discusses the relationship of self-attitudes to multiple modes of deviance including suicide and drug abuse. He believes that a common factor underlies such behavior, in that the development of characteristically negative self-attitudes may be conducive to both. Such self-attitudes derive from a person's experiences in his membership group which lead to self-perceptions of failure. A person perceives a failure to cope within the group's norms, and turns to deviant behavior by rejecting these norms to correct his self-attitude. Kaplan cites data suggesting that negative self-attitudes are antecedents of socially deviant behaviors of various sorts in adolescents. Kaplan thus suggests that deviant behavior arises as an alternative form of coping in those that are socially rejected. Saxon, Aldrich, and Kuncel (1978) and Cuskey (1978) have also alluded to the possibility that drug abuse may be a form of self-destructive behavior. The notion that drug abuse and suicide are functionally equivalent, because they both lead to early death, taken with evidence that both are responses to a failure of the individual's coping mechanisms, suggests some commonality. These researchers entertain the notion that some commonality of determination underlies a wide number of self-damaging behavior patterns because there are similarities in both antecedents and consequences.

It would be premature to make strong statements about a functional equivalence of suicide and drug abuse based alone on commonalities in antecedents and consequences. However, it is also premature to dismiss the possibility that some etiological factors are in some cases common to those of suicide. In light of the discussions in Chapters 7 and 8, it is apparent that natural selection would support a general motivational orientation toward survival only when effective coping (promotion of inclusive fitness) was possible. A general change in motivation away from survival, due to gene-expression changes corresponding to change in selective pressures when ef-

fective coping is prevented, could conceivably be reflected as much in chronic self-abuse as in discrete suicidal actions. The topography of the self-damaging behavior differs in cases of drug abuse and discrete acts of suicide; this topography may reflect experiential differences, whereas the motivational state may in some cases be similar. Kaplan's (1978) interpretation of the relationship of negative self-attitude or coping failure to self-damaging behavior may be in error. He views the self-damaging behavior as an alternative coping strategy. While many forms of deviant behavior occurring after failure to cope through more conventional means may fit his notion, this could not apply to severely self-damaging behavior. In a biological sense, self-damaging behavior is hardly an alternate strategy for survival. Rather, it may reflect a general change in motivation occurring when coping failure seems inevitable, in accordance with selective pressures discussed in Chapter 8. Furthermore, the relationship of coping failure and various self-damaging behavioral patterns may simply reflect pathological conditions that were discussed in Chapter 7.

The most striking sociobiological aspect of drug abuse remains the fact that we could not possibly be biologically predisposed to behave adaptively in the presence of so many novel pharmacological substances. However, this notion must be tempered with the consideration that self-administration of drugs may in some circumstances facilitate adaptation, although the facilitation may often be of a short-term nature at a long-term cost. It also remains conceivable that serious drug abuse reflects a major motivational dimension that also determines suicide. A general motivational orientation away from self-preservation is predicted by selective pressures for individuals who have lost the ability to promote their inclusive fitness. This motivational change could be reflected in different manners in different individuals, dependent on a wide range of differences in experience and genetics. These potential determinants of drug abuse are by no means mutually exclusive. It is not unlikely that they act in combination to produce different syndromes of drug abuse, and that the balance of determinants differs markedly among different cases. The major challenge for sociobiological research and theory is to determine the balance of these and other factors in determining chronic self-abusive patterns.

Other Chronic Self-Abuse

It is very likely that only a small proportion of the modern human population optimizes adaptation by adhering to appropriate habits of diet, exercise, drug consumption, and other aspects of lifestyle. Modern lifestyle differs in so many respects from that prevailing during human evolutionary history that there are undoubtedly many pathological or semimaladaptive chronic

behavioral patterns in the current population. Another example is found in the phenomenon of obesity, which may in part be engendered by dietary novelties, such as refined sugar, and reduced requirements for physical exercise. In many manners, the quality of life and human longevity have been improved by technological and social innovations. But we are so far from our natural evolutionary context that a large proportion of each generation is likely to fail in adaptation and reproduction. It is this failure in reproduction that will ultimately return some level of equilibrium to new generations. Those that optimize their coping chances by behaving judiciously are likely to prosper and propagate.

It could be argued that what will be favored in modern human evolution is a strong cerebral cortex. Those capable of learning from experience and attending to information available in the culture on present dangers and rewards may be most likely to survive and reproduce. It is unlikely that our motivational structure will change sufficiently to accommodate the diversity of specific dangers to survival that now exist. Rather, those who can inform themselves as to these dangers and who can suppress evolutionarily older motivational predispositions that are now out of context may be most likely to prosper.

Risk Taking

Another set of data that may in some indirect manner relate to suicide are those on accidents and risk taking. One potential connection is that some of those taking excessive risks of death, and whose deaths when they do occur may be recorded as accidents, may actually have some suicidal motivation underlying their actions. Many of the phenomena discussed above under the headings of chronic self-abuse and parasuicide may be viewed as instances of excessive risk taking. I would like very briefly here to consider whether other forms of accidental death may involve a suicidal component.

Shneidman (1968) developed the notion of subintentioned death, which he apparently meant to include cases of chronic self-abuse and excessive risk taking. Subintentioned death is defined to encompass instances in which the individual plays an indirect, covert, partial, or unconscious role in his or her own demise. Shneidman included such attributes or behaviors as imprudence, carelessness, forgetfulness, lack of judgment, neglect of self, poor-risk gambles, and mismanagement of drugs. This clearly covers a wide variety of behavioral patterns.

Tabachnick (1973) has analyzed data on automobile "accidents" in the United States, arguing that many of these may involve some component of suicidal motivation. He cites the figure that 54,800 people died from

automobile accidents in the United States in 1970, which is about twice the number of deaths recorded from suicide. He asks us to consider that automobile accident is only one modality of accident, and thus that the totality of accidental deaths is very high. Within a psychoanalytic framework, Tabachnick argues that risk-taking behavior may reflect an unconscious motivation to die, making many accidents in fact hidden suicides.

Mellinger (1978) has also discussed the phenomenon of risk taking as related to suicide. He cites one study of seat belt usage in the Oakland area of California in 1963 when seat belts were not compulsory. The percentage of persons owning seat belts was high among better educated people and especially low among the divorced or separated. He suggested that many other opportunities for studies of risk are available, such as the study of medical care behavior; he notes that men go to the doctor less frequently than women do. Mellinger appears to adopt Menninger's (1938) notions that a wide variety of risk taking and chronic self-abusive behavioral patterns are self-destructive in nature.

Insurance companies keep fairly thorough statistics on mortality due to accidents of various sorts, which should provide a data source for investigators of risk taking. The Metropolitan Life Insurance Company (*Mortality from Leading Types of Accidents*, 1978) gives a death rate from accidents in 1975-1976 of 68.5 per 100,000 population per year among males and 27.9 among females. In Table 15.1 is given a further breakdown of these statistics by age, sex, and type of accident. The highest rates among both males and females seem to be in adolescence-young adulthood and old age.

The information in Table 15.1 bears some relationships to information about suicide discussed in Chapters 2 and 5. Not only is the sex ratio similar, but the role of technology in accidents is fairly striking. Arguments made for suicide about the role of technology (see Chapters 6 and 7) could in many instances equally be applied to accidental deaths. The novel environment provided by many modern technologies is one for which biological adaptation could not have occurred, because an insufficient number of generations has passed for genetic adaptation to be engendered by selective presures. This by no means suggests that suicides and accidents represent a unitary phenomenon. However, we are led to ask whether death in the presence of novel technology that involves a conscious component (suicide) is necessarily different from inadvertent death engendered by technology. Is there any substantial reason why higher cognitive functions involved in suicide contemplation would be any more adapted to the modern situation than are cognitive functions mediating accident avoidance?

It would be interesting to conduct a thorough analysis of statistics on accidental death; this presents an important research opportunity. Particularly meaningful might be an analysis of reproductive status; it is well known that

Table 15.1
Mortality from Leading Types of Accidents, United States, 1975-1976.

Type of accident	All ages	1-4	5-14	15-19	20-24	25-29	30-34	35-44	45-54	55-64	65 and over
	Male										
Accidents—all types	68.5	32.9	23.9	88.2	103.3	78.9	63.7	60.6	62.4	71.9	137.0
Motor vehicle	32.5	11.9	11.0	58.9	65.1	44.5	33.5	28.7	25.9	26.3	38.1
Traffic	31.8	10.0	10.6	58.0	64.2	43.8	33.0	28.1	25.3	25.6	37.1
Pedestrian	5.0	5.5	4.2	4.2	4.4	3.6	3.4	3.9	4.8	5.6	11.8
Nontraffic	.7	1.9	.4	.9	.9	.7	.5	.6	.6	.7	1.0
Falls	7.2	1.2	.5	1.8	2.4	2.3	2.6	3.7	6.5	10.3	47.3
Drowning	4.9	7.3	4.6	9.9	7.6	4.9	3.8	3.2	3.0	2.8	2.8
Fires and flames	3.7	5.5	1.7	1.3	2.2	2.4	2.3	2.8	4.2	5.9	10.5
Poisoning by solids and liquids	2.8	.8	.2	2.1	7.6	7.1	4.3	3.3	2.4	1.9	2.0
Firearms	1.8	.6	1.7	3.3	2.9	2.1	1.7	1.7	1.5	1.4	1.3
Accidental deaths as a percentage of all deaths	7	42	55	61	51	41	32	18	7	4	2
	Female										
Accidents—all types	27.9	23.0	10.9	26.0	22.8	17.9	15.8	17.3	21.0	27.0	86.1
Motor vehicle	11.5	8.8	6.2	20.3	15.9	11.3	9.4	9.0	9.3	10.8	16.3
Traffic	11.3	7.3	6.1	20.1	15.8	11.2	9.3	8.9	9.2	10.6	15.9
Pedestrian	2.1	3.2	2.5	1.8	1.1	1.0	1.1	1.2	1.6	1.9	5.0
Nontraffic	.2	1.5	.1	.2	.1	.1	.1	.1	.1	.2	.4
Falls	6.4	.9	.2	.3	.3	.3	.4	1.0	2.1	3.8	44.7
Fires and flames	2.2	4.8	1.4	.8	1.0	.9	.9	1.2	1.9	2.8	5.9
Poisoning by solids and liquids	1.3	.6	.1	.9	1.9	1.8	1.6	1.9	2.1	1.8	1.5
Inhalation and ingestion of food or other object	1.2	1.0	.2	.3	.3	.4	.5	.8	1.1	1.8	3.8
Drowning	1.0	3.6	1.1	.9	.9	.7	.6	.5	.6	.6	.9
Accidental deaths as a percentage of all deaths	4	37	40	48	35	24	16	9	5	3	2

Source: Metropolitan Life Insurance Co. Statistical Bulletin. July-September. 1978. Adapted with permission.

insurance companies view married individuals as much less of a risk, which again suggests a correspondence to suicide data. It is the inadvertence of accident that primarily differentiates it from suicide. This implies primarily a cognitive difference, or one of "intent." As was discussed in Chapter 2, defining suicide in terms of intent is not necessarily meaningful in a biological sense. However, there remains a meaningful difference between accident and suicide. Accidents often occur while an individual is in the course of engaging in some clearly adaptive behavior. For example, many automobile drivers die in accidents on their way to work or some other clearly adaptive function; the driving behavior is oriented toward a life-preserving end. Suicidal behavior is directly oriented toward death.

A large potential payoff may justify a considerable amount of risk of death, and thus much risk-taking behavior fits readily within the predominant life-preserving orientation of behavior. Also, many of those dying by accident through carelessness or the taking of unwarranted risks may simply not have learned sufficiently about the potential adverse consequences of their action. None of such behavior constitutes suicide. Nonetheless, it is possible that many deaths labeled as accidents do involve a suicidal component. There are many possible relationships between suicide and accident, and undoubtedly different causations are involved in different cases. Many psychiatrists appear to have been too hasty in accepting the notion that suicidal motivation underlies a large number of accidents. The causation of all such behavioral patterns is exceedingly complex and multifarious, and additional research is clearly needed before any strong inferences are drawn.

Other Self-Damaging Behavioral Patterns

In an even more cursory manner, I would like now to survey other potentially self-damaging forms of behavior in the human population.

Masochistic Behavior

Frieden (1978) has presented evidence that normal individuals will, under some circumstances, select for aversive stimulation. When given false negative feedback regarding their personalities, many subjects chose to perform an aversive task rather than a neutral task. Frieden suggests that normal individuals may respond to a lowering of self-esteem in a self-punitive manner. Masochistic individuals in this sample generally had lower self-esteem than normal subjects. While this effect requires further examination and may be subject to other interpretations, it is consistent with evidence that life-

threatening behavior is brought on by low self-esteem and coping failure (see Chapters 5, 7, and 9).

Homosexuality

Homosexuality presents a problem for sociobiological analysis, especially where it excludes heterosexual activity. An exclusively homosexual person fails to propagate his or her genes and thus apparently behaves in a manner that is detrimental to his or her fitness. Yet estimates of the incidence of exclusive homosexuality in Western cultures range at least as high as 4% of males and 1% of females, with much larger proportions of the population engaging in homosexual behavior at some time during their lives (Davison & Neale, 1978). Homosexual behavior is also found in many other species and in diverse human cultures throughout recorded history.

E. O. Wilson (1978) has argued that homosexuality may be normal in a biological sense. He argues that it is a form of bonding, as is much of heterosexual activity. He suggests that close relatives may have been able to have more children as a consequence of homosexual behavior, and that by being freed from the special obligations of parental duties, homosexuals may have been able to operate with special efficiency in assisting close relatives. Hence, homosexual behavior may have been transmitted via kin selection. Clearly this question requires more attention from sociobiologists. Especially valuable would be data on the phenomenon in lesser developed and ecologically stable cultures. It is quite conceivable that in the modern situation the behavior is often occurring out of context (see also Ridley & Dawkins, 1981), and that at least part of the phenomenon is of purely cultural origin.

Other Reproductive Failures

A failure to engage in reproductive activity clearly reduces individuals' capacities to propagate their genes, although kin- and possibly group-favoring behavior may compensate. DeCatanzaro and Gorzalka (1981) have discussed reproductive failures involving impotence or sexual disinterest. Most forms of impotence, for example, appear to be psychogenic in nature rather than being related to any form of physiological pathology. DeCatanzaro and Gorzalka discuss how such impotence may be stress-induced. Celibacy and other forms of voluntary sexual abstinence are also curiosities; that imposed by the Roman Catholic religion on its priests, monks, and nuns appears to be expressly designed to foster altruism. Another interesting opportunity for study lies in modern birth control practices; despite the many benefits that the birth control pill offers for population regulation, it is an ecological novelty that could conceivably adversely affect the fitness of some of its users.

Failures in Nurturance of Offspring

Cases of child abuse and neglect seemingly involve a loss in inclusive fitness. This problem has been addressed in a biological framework by Daly and Wilson (1980) and by Wilson, Daly, and Weghorst (1980). These researchers have found that abuse and neglect are maximal in father-only homes and minimal in two-natural-parent homes. Mother-only homes exceed those with only one natural and one stepparent in neglect incidence, but the reverse is true for abuse incidence. Poverty is also associated. The presence of an unrelated adult filling a parental role may exacerbate the risk of child abuse. Differential treatment of offspring or concentration on the welfare of some offspring, even including infanticide, has a long history in many species, and may actually be an optimal strategy in parenting where resources are limited.

Behavior in Warfare

In times of war between societies or civil war within one society many individuals engage in behavior that clearly threatens their survival. A society may also threaten its continued existence in warfare. But there are potential benefits that motivate such behavior. Hamilton (1975) has considered the sociobiology of warfare from the viewpoint of population genetics. He has argued that warfare is most likely between the most geographically distant and least genetically related groups of accessible fellow human beings. For a society to engage in warfare, particularly in times of scarce resources, may be adaptive insofar as success may increase available resources and directly or indirectly bring reproductive benefits. Pillaging, plundering, and raping may have motivated much soldiering during human history. A soldier may also be motivated by factors of altruism discussed in Chapter 9, in that the welfare of his genes as they exist in others may be contingent on the success of his society. War may bring many changes in population number and genetic composition, in that it selectively extracts various elements from the population. Warfaring behavior is of a high-risk nature, with many potential benefits and losses, and has had a long history in the human species. Modern technological changes have dramatically altered the stakes of warfare, making the expression of warlike tendencies derived from our evolutionary past a potentially highly self-destructive enterprise.

Summary and Conclusions

There is a wide range of behavior in the human population that shares with suicidal behavior a high risk of death as a consequence. The determination of such behavior is highly complex; it involves many unique considerations for each particular behavioral pattern. There are some apparent com-

monalities with suicide; the most striking of these are the predominantly higher incidence of life-threatening behavior among males and the involvement of ecological novelties in many forms of modern maladaptive behavior. Also, stress and coping failure appear to facilitate diverse forms of life-threatening behavior. However, liberal statements about a common underlying factor in life-threatening behavior are unwarranted at this point in scientific development. The many topics discussed in the present chapter each require a substantial amount of further research, and thorough sociobiological analyses would warrant several volumes of discussion. There is much room for further work on these topics.

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Self-Injurious or Self-Mutilative Behavior

I would like now to discuss what has been called *self-injurious behavior,* which has been defined as repetitive, stereotyped behavior that produces immediate, obvious physical damage to the individual (Bachman, 1972; deCatanzaro, 1978; Lester, 1972a; Tate & Baroff, 1966). This behavior might more properly be called *self-mutilative behavior* to avoid confusion with acts of parasuicide, which have also occasionally been labeled as self-injury or self-injurious behavior. As discussed in Chapter 2, repetitive self-mutilative behavior is common among particular human clinical populations, especially those diagnosed as severely or profoundly retarded, autistic, or schizophrenic. Very similar behavior has also been observed in stressed primates and other nonhumans in captivity or experimental settings (see Chapter 4). Such behavior includes patterns such as head-banging, self-hitting, self-scratching, and self-biting. In its more severe cases it is clearly life-threatening, with the individual almost incessantly engaging in it and showing little other behavior. It has been known to produce laceration, severe bleeding, blinding, concussion, and a variety of other serious physiological insults (see, for example, Bachman, 1972; deCatanzaro & Baldwin, 1978).

Self-injurious or self-mutilative behavior has usually been interpreted within a psychoanalytic framework (e.g., Cain, 1961; Ferenzi, 1955; Frances & Gale, 1975) or within the framework of learning theory (e.g., Bachman, 1972; Carr, 1977; Ferster, 1961; Smolev, 1971). The psychoanalytic approach has concentrated on a "surfacing death wish" or on attempts by the individual "to differentiate himself or herself from the object world." The learning approach has been exceeding popular and remains so today, generating a large amount of research primarily oriented toward clinical modification of the behavior. This learning approach has concen-

trated on the control of this behavior by very proximate antecedent and consequent stimuli, and has been much more scientific than the psychoanalytic approaches. My purpose in this chapter is to argue that self-mutilative behavior may be better explained within a biological context. There is a wealth of evidence suggesting that physiological and developmental abnormalities are highly correlated with such behavior. There are several simple causal mechanisms by which such abnormalities may be directly conducive to self-mutilative behavior. I will argue that physiological and developmental abnormalities, by placing individuals in circumstances that are highly different from their natural environment, are conducive to very abnormal behavior. It will follow from this analysis that learning is only a secondary determinant of the behavior, whereas many of the psychoanalytic approaches have little validity.

Hence, I would like to concentrate upon self-injurious behavior because it is unequivocally life-threatening and because the data are in serious need of reinterpretation. It is not my purpose here to make too liberal analogies between self-injurious behavior and other forms of self-damaging behavior, although some commonalities of causation do appear to be present. There are many determinants of self-injurious or self-mutilative behavior that are not found for other forms of self-damaging behavior.

The Role of Learning

Learning theorists have advanced the notion that self-mutilative behavior develops through normal conditioning processes. Ferster (1961) postulated that the behavior develops through operant conditioning in that it is reinforced by attention it receives from observers. Since self-injurious behavior usually evokes an immediate response, it gives individuals a means of controlling the behavior of those around them. Accordingly, it constitutes freely emitted behavior that is shaped and maintained by environmental contingencies. A considerable amount of research has been generated by this hypothesis.

Schaeffer (1970), for example, found that he could shape head-banging in rhesus monkeys by reinforcing successive approximations to this behavior. He maintained head-banging at stable rates sufficient to produce lacerations, and developed stimulus control over it through discriminative techniques. Head-banging extinguished when reinforcement was removed and reestablished when reinforcement was reinstituted. Other animal research supports this learning model in a more indirect manner. It has been demonstrated, for example, that aversive stimuli can be made reinforcing by

establishing them as discriminative stimuli or conditioned reinforcers (e.g., Ayllon & Azrin, 1966; Azrin & Holz, 1966; Stubbs & Silverman, 1972).

Additional support for an interpretation based on operant conditioning comes from numerous reports of modification of self-mutilative behavior through operant techniques. These reports have been reviewed by Bachman (1972), Carr (1977), Frankel and Simmons (1976), and Smolev (1971). The contingent application of aversive stimulation, such as shock, is reported to be quite effective (Bucher & Lovaas, 1968; Lovaas & Simmons, 1969; Risley, 1968; Tate & Baroff, 1966). Differential reinforcement of other behavior (e.g., Allen & Harris, 1966; Corte, Wolf, & Locke, 1971; Peterson & Peterson, 1968) and time out from reinforcement (e.g., Hamilton, Stephens, & Allen, 1967; Tate & Baroff, 1966; Wolf, Risley, & Mees, 1964) have been reported to be moderately successful.

An interpretation that self-mutilative behavior patterns develop through conventional conditioning processes entails that they have adaptive value in the same sense as do most other conditioned responses. Reinforcement and punishment can be viewed as orienting the organisms toward events which increase their biological fitness. It is implicit in this first learning model that the reinforcement accruing to the individual through self-injury is sufficient to outweigh losses in fitness produced by the behavior. It would seem logical that, in a normal individual, the balance of positive and negative consequences determines whether a response will be reinforced or punished. Given this assumption, the model would imply that the positive consequences outweigh the negative.

Maladaptive Learning

Other learning models appear to view repetitive self-mutilative behavior as the product of conditioning processes that act in abnormal manners because of extraordinary circumstances. A few animal experiments (Byrd, 1969; Stretch, Orloff, & Dalrymple, 1968) have illustrated one way in which this might occur. In these experiments animals first learned to avoid an aversive stimulus. After several trials, the same aversive stimulus was gradually made contingent on the learned avoidance response. This contingency actually increased responding; thus the aversive stimulus "reinforced" the response. These are generally transient laboratory phenomena and only suggest by analogy factors that could be involved in development of naturally occurring self-mutilative behavior. Self-injury in humans may be maintained for years, and there is little direct evidence for the occurrence of such unusual reinforcement contingencies in human cases. Nonetheless, it remains possible that unusual forms of conditioning contribute to self-injurious behavior; some possibilities will be discussed below in relationship to physiological variables.

Criticisms of Learning Models

Several difficulties exist with interpretations based exclusively on learning. Some of these have been discussed extensively elsewhere (deCatanzaro, 1978). Essentially, learning models may not account adequately for the extremely high rates (deCatanzaro & Baldwin, 1978; Lovaas & Simmons, 1969) and rhythmicity (deLissovoy, 1963) of the behavior, its association with clinical syndromes involving physiological abnormalities (Bryson, Sekati, Nyhan, and Fish, 1971; Landwirth, 1964; Lesch & Nyhan, 1964; Parker, Mavalwala, Weise, Koch, Hatashita, & Cibilich, 1970), the involvement of developmental variables (Cross & Harlow, 1965; Mason & Sponholz, 1963), and the relatively spontaneous occurrence of the behavior in stressful situations (Frieh, 1942; Gluck & Sackett, 1974). Moreover, evidence from within operant research questions learning models. Attempts to extinguish self-injurious behavior by removing all contingent reinforcement (e.g., Bucher & Lovaas, 1968; Lovaas & Simmons, 1969; Lucero, Frieman, Spoering, & Fehrenbacher, 1976; Myers, 1975; Ross, Meichenbaum, & Humphrey, 1971) have generally failed. There appear to be no reported cases where the frequency declined to and was maintained at zero levels following withdrawal of social reinforcement. Other attempts to modify the behavior through punishment and schedules of reinforcement (e.g., Muttar, Peck, Whitlow, & Frazer, 1975; Romanczyk & Goren, 1975) have been unsuccessful. Also, a systematic analysis of reinforcement contingencies in five cases by Dizmang and Cheatham (1970) found little evidence of involvement of social reinforcement.

Despite the now widespread use of operant conditioning techniques to treat self-injury, this behavior remains common within many institutions. This persistence may reflect inappropriate or unsystematic approaches to treatment. However, the failure of many systematic treatments raises serious doubts concerning hypotheses based exclusively on learning. Moreover, many of the reports of successful treatment through conditioning techniques may have been confounded by other variables. Any technique that involves presentation of positive reinforcement also may increase the amount of attention received by the subject and decrease the amount of social isolation and stress he experiences. As will be discussed below, stress and social isolation alone may be critical determinants.

There are numerous examples of findings from the operant treatment literature that can be readily interpreted in terms of variables unrelated to conditioning. For example, several studies have been purported (Carr, 1977) to demonstrate stimulus control of self-mutilative behavior through differential reinforcement. Bucher and Lovaas (1968) reported that the behavior was high when one child was in the presence of adults but low otherwise. Carr, Newsom, & Blinkoff (1976) observed high levels of self-

injury when children were in high-demand situations (such as a classroom) compared to low-demand (free play) situations. Peterson and Peterson (1968) found high rates in one child when reinforcing objects were withdrawn from him. All of these findings may be interpreted as showing greater incidence of self-injury in stressful than nonstressful contexts rather than stimulus control. As I will discuss below, acute stressful stimulation may set the occasion for self-mutilative behavior due to nonassociative physiological effects that are independent of reinforcement variables.

The hypothesis that self-mutilative or self-injurious behavior constitutes adaptation may be particularly untenable. The severity of the behavior rules out this hypothesis unless it can be demonstrated that extrinsic reinforcers in severe cases are extremely powerful. It might be advantageous for an individual to self-inflict mild tissue damage to receive attention from others. However, where an individual's basic physical requirements, such as food and shelter, are supplied regardless of behavior, as is the case in most institutions, it does not seem plausible that he or she should blind, maim, or otherwise permanently harm himself or herself simply to receive social reinforcement. The position that self-injurious behavior is learned through conditioning processes that fail, because of exceptional circumstances, to adapt the organism is more plausible but without direct support. Further analysis of natural contingencies affecting the behavior is required.

Although research indicates that many clinical cases respond to extrinsic reinforcers, the assertion that environmental contingencies cause the behavior remains theoretical. A demonstration that behavior is responsive to experimental manipulation of environmental variables does not implicate such events in the natural development and maintenance of that behavior. Additional research demonstrating development of self-injury through reinforcement and its elimination through extinction would be required to support strongly models based exclusively on conditioning. The evidence may be sufficient at present to suggest that reinforcement contingencies are secondary determinants. Reinforcement may influence the frequency and topography of the behavior after it has developed, but is not necessarily involved in its development nor the exclusive factor controlling its maintenance. It is also premature to conclude that learning variables are involved in the etiology or maintenance of all forms and individual cases of self-injurious behavior. Rather, the evidence suggests that some cases are more responsive to environmental manipulations than are others.

Physiological Malformation and Damage

I would now like to argue that several physiological factors could directly produce self-injurious behavior. Despite the fact that brain damage and

severe behavioral deficits are highly correlated with the behavior, physiological variables have been given only brief mention in previous theoretical analyses.

Physiological abnormalities are common, if not ubiquitous, in populations displaying self-injurious behavior. One human grouping in which it is quite common consists of individuals with severe or profound mental deficiency (van Velzen, 1975). In these populations, the incidence of severe neurological damage and malformation is known to be quite high (Harris, 1972; O'Connor, 1972). Indeed, Maisto, Baumeister, & Maisto (1978) report that the prevalence of self-injury is clearly associated with the level of retardation, being more common with more severe retardation. Individuals displaying self-injurious behavior are very commonly diagnosed as being brain damaged. Also, several syndromes involving genetic mutation, chromosomal aberration, congenital malformation or damage, and metabolic disorders have been linked to the behavior. These include the Lesch-Nyhan syndrome (Lesch & Nyhan, 1964; Watts, 1978), the Cornelia de Lange syndrome (Bryson *et al.*, 1971; Singh & Pulman, 1979), the 47XYY syndrome (Parker *et al.*, 1970), and the 49XXXXY syndrome (Korten, Van Dorp, Hustinx, Scheres, & Rutten, 1975). It is commonly reported that self-injury is associated with some form of sensory neuropathy (Landwirth, 1964; Maisto *et al.*, 1978).

A major role of neurological damage or malformation is also strongly suggested by animal research. Experimentally induced physiological disturbances, such as decerebration (Hendrick, 1950), temporal lobe lesions (Kluver & Bucy, 1939), and intervention in the caudate nucleus (see Korten *et al.*, 1975) have all been found to produce self-injurious behavior in nonhuman mammals. Middle ear infection (otitis media) has been found to relate in both humans (deLissovoy, 1963) and laboratory mice (Harkness & Wagner, 1975). Recently, it has also been reported (Dennis & Melzack, 1979) that dorsal rhizotomy in a forelimb in rats may lead to self-mutilation of the limb. Such evidence suggests that physiological abnormalities of a diverse nature may be conducive to the behavior. I would now like to postulate some mechanisms that may be involved in the various individual cases.

Abnormalities in Pain Avoidance

One possible means by which neurological damage and malformation could directly facilitate self-injurious behavior is through interference with normal conduction of nociceptive or pain information. Although neural pathways mediating pain are numerous and diffuse (Pourier, Bouvier, Olivier, & Boucher, 1968) it is possible to identify pathways and structures whose damage or malformation might interfere with normal pain perception.

Lesions at particular levels of the spinal cord (Pomerantz, 1973; Pourier *et al.*, 1968) and certain thalamic nuclei (Mark, Ervin, & Yakovlev, 1962) can affect specific modalities of pain. In the cortex, parietal lobe lesions can leave an individual sensitive to pain but unable to avoid it, while frontal lobe lesions can render an individual relatively indifferent to pain (Freeman & Watts, 1950; Melzack, 1973). Furthermore, there is now evidence that biochemical systems exert considerable control over nociceptive information. Endogenous biochemicals known as endorphins (see Chapter 10) are known to modulate pain sensitivity and may account for much of the variance among and within normal individuals in responsiveness to physical injury (Barchas, Akil, Elliot, Holman, and Watson, 1978; Goldstein, 1978; Hughes, 1975). It is conceivable, therefore, that diffuse neurological abnormalities could interfere with the normal biochemical balance necessary for pain avoidance. In some members of the human population, brain damage or malformation and biochemical disorders may be sufficiently severe to disrupt the pathways, structures, and biochemical systems mediating pain. Many of these individuals would probably fall within the populations demonstrating self-injurious behavior, where brain damage or malformation is characteristic.

Another consideration is that most individuals who exhibit self-injurious behavior direct the behavior to limited areas of their body. Over time, the peripheral nerve tissue in the area could be destroyed and callousing of the skin could develop, sharply reducing sensitivity to nociceptive information.

It might be argued that problems in pain perception could not be involved in self-injury since this behavior can often be decreased by contingent shock (e.g., Bucher & Lovaas, 1968; Lovaas & Simmons, 1969). In cases where shock is effective, a total indifference to all forms of pain may not occur. This would not eliminate, however, the possibilities that such individuals have increased pain thresholds or are relatively insensitive to specific modalities of pain. Furthermore, the effectiveness of aversive treatment has only been demonstrated for a small sample of self-injuring individuals. Reports of cases that are refractory to treatment with aversive contingencies (Muttar *et al.*, 1975; Romanczyk & Goren, 1975) may indicate that behavioral sensitivity to nociceptive stimulation is actually quite low in many cases.

Stereotypies and Motor Dyscontrol

Another physiological possibility is that self-mutilative behavior derives from stereotypic forms of behavior. Stereotypies are evident in most of the classes of organisms that display the behavior. Caged primates (Berkson, 1967), monkeys raised in social isolation (Cross & Harlow, 1965), animals given catecholamine stimulants (Randrup & Munkvad, 1969), the institutionalized retarded (Berkson & Davenport, 1962; deCatanzaro & Baldwin,

1978), autistic children (Rimland, 1964) and schizophrenics (Green, 1967) have all been reported to show both stereotypies and self-injurious or self-mutilative behavior. These stereotypies generally consist of fixed, repetitive movements that are followed by no apparent extrinsic reinforcement. Indeed, self-injurious behavior itself may be classified as stereotypic behavior, since it usually consists of fixed, repetitive movements.

Thelen (1979) has recently reviewed evidence on rhythmical stereotypies in normal human infants. Naturalistic, longitudinal observation of infants during their first year showed that they performed a great quantity of rhythmical and highly stereotyped behavioral patterns. A variety of movement patterns occurred, involving limb, digit, and head movements with the whole torso in various postures. These patterns showed developmental regularities as well as constancy of form and distribution. The onset of particular stereotypy groups was highly correlated with motor development. Thelen proposed that rhythmical stereotypies are manifestations of incomplete cortical control of endogenous patterning in maturing neuromuscular pathways. This research has major potential importance for the understanding of stereotypies and self-injury in the mentally disadvantaged. Brain damage and malformation may impede normal motor control by cortical functions, causing stereotypies to persist beyond their normal developmental period. In conjunction with pain perception and response inhibition deficits, such stereotypies could engender self-injurious behavior.

DeCatanzaro and Baldwin (1978) found that an effective treatment of self-injurious behavior involved a daily physical interruption of the response through a forced arm exercise. By breaking the behavioral sequence through a firm exercise applied immediately contingent upon its commencement, self-injurious behavior soon was reduced to a very low frequency. The stereotypic movement pattern was deconditioned; this was most effective when coupled with the delivery of totally noncontingent and intense social reinforcement.

Stereotypies among those with severe neurological and developmental abnormalities may result from behavioral simplicity consequent to such abnormalities. A very small behavioral repertoire may stress bodily tissues involved in the repeated motor patterns. Also, motor dyscontrol may result from neurological damage; indeed, motor problems are reported to be common among those displaying self-injurious behavior (Watts, 1978). Severe damage to or malformation of motor cortical areas, the cerebellum, the basal ganglia, or pyramidal and extrapyramidal fibers could perhaps directly produce stereotypies and/or self-injury. If relatively few, rigid motor patterns are present, any form of motor activation might induce these patterns, regardless of motivational variables. Such motor problems could prevent responsiveness of behavior to reinforcement, punishment, or other environmental

events. Rigid and repetitious behavior may set the stage for social reinforcement of self-injurious behavior (Green, 1967), as will be discussed in more detail later.

Stereotypic Self-Injurious Behavior and Neurochemistry

Pharmacologic studies of animal behavior indicate that some stereotypies may result from abnormalities in neurotransmission. Stereotypies can be produced in most mammalian species, including humans, through injection of high doses of catecholamine stimulants such as amphetamine (Lammers & van Rossum, 1968; Randrup & Munkvad, 1969, 1974). Occasionally, a drug-induced stereotypic movement, such as biting, may become self-directed, in which case it may produce marked damage to the individual's body (Randrup & Munkvad, 1969). Self-injurious behavior of this nature has been reported in mice treated with clonidine (Razzak, Fujiwara, and Ueki, 1975) and rats treated with pemoline (Genovese, Napoli, & Bolego-Zonta, 1969) and caffeine (Peters, 1967). One suggestion has been that such stereotypies result from a hypersensitivity in dopamine receptor sites (Klawans & Margolin, 1975; Segal, 1975).

Unfortunately, there are not many published studies of the effects on human self-injury of pharmacologic agents affecting specific neuroregulatory systems, although medical staff in many institutions may frequently administer drugs to those affected. Davis, Sprague, & Werry (1969) have found that human cases can be aggravated by catecholamine stimulants and reduced by catecholamine antagonists. Similarly, Burk & Menolescino (1968) found that haloperidol, a drug blocking dopamine action, reduced the behavior. However, Corbett (1975) reported that haloperidol and chlorpromazine, which also blocks the action of dopamine, were ineffective in reducing self-injury in the Lesch-Nyhan syndrome. Schroeder, Schroeder, Smith, and Dalldorf (1978) have reported that neuroleptic treatment was effective in 32% of cases in a large institution for the retarded. Hacke, Büssing, and Jungen (1978) have reported, in a double-blind study, that the drug methylperon (Eunerpan) reduced the frequency of "auto-aggression" among mentally retarded female patients.

There is one report (Lycaki, Josef, & Munetz, 1979) of successful treatment of two cases of self-injurious behavior with methylphenidate, which is actually a catecholamine stimulant. However, the form of self-injury was not clearly specified in this report, and the subjects appear to be more like those displaying parasuicidal behavior, being adult females of normal intelligence with symptoms of depression.

There is also a report that drugs stimulating GABAnergic activity may influence self-injurious behavior. Primrose (1979) reported that baclofen, a

chlorphenyl derivative of the neurotransmitter gamma-aminobutyric acid (GABA), produced a diminution in the amount of self-injury in many, although not all, cases in a sample of mentally deficient individuals. He argued that GABA, in addition to being a muscle relaxant, is a major inhibitor in many areas of the brain, including the cortex and basal ganglia, and that damage in these areas in some severely subnormal defectives might produce deficiencies in this inhibitor. It is conceivable that different forms of damage or malformation in different individuals affect different inhibitory neurochemical systems; this would account for variance among individuals in responsitivity to particular drugs or other treatments.

Even where pharmacologic agents have had effects on chronic self-injury, it is possible that they have nonspecific effects on motor initiation and maintenance. It is thus premature to conclude that there is a functional similarity between pharmacologically induced self-mutilation in animals and naturally occurring human cases, but there is clearly need for further systematic study here.

Abnormalities in Reinforcement Mechanisms

Dysfunction of brain reinforcement and punishment mechanisms, which could respectively relate to stereotypies and pain perception problems, may also be involved. There is growing evidence that reinforcement is mediated by inherited circuits in the brain, and that catecholamines play an important role in these circuits (Mogenson & Phillips, 1976; Routtenberg, 1978; Stein, 1978; see also Chapter 10). Reinforcement processes normally shape behavior such that it becomes oriented toward stimuli that facilitate the individual's adaptation, while less adaptive responses generally decrease in frequency. Self-injurious behavior could thus be facilitated by damage or malformation of structures involved in reinforcement or by biochemical abnormalities affecting the neurochemical systems mediating reinforcement.

It is conceivable that self-injurious behavior actually is intrinsically reinforcing in individuals with deficits in pain, punishment, or other inhibitory mechanisms. In individuals with such deficits, a head-bang or head-hit would not punish itself. However, such behavior might generate kinesthetic or tactile stimulation, which could be inherently reinforcing, especially for those that are stimulus deprived. This may relate again to stereotypic behavior, which has also been called "self-stimulatory" behavior (e.g., Foxx & Azrin, 1973). This may also relate to brain reinforcement mechanisms. Mild acute stressful and novel stimulation is known to produce a transitory elevation in brain catecholamines (Anisman, 1978). Since increased catecholaminergic activity may activate reinforcement mechanisms in the brain (Mogenson & Phillips, 1976), the probability of head-bands or head-hits may be increased

insofar as such behavior constitutes mildly stressful stimulation, although such a possibility remains uninvestigated.

Cognitive Deficits

It is also conceivable that, in organisms with cortical malformation or damage, particularly where there is an absence of association cortex or fasciculi between sensory and motor cortical areas, associations between consequences and actions may not occur. For such individuals, the contingency between self-injurious behavior and the slow, cumulative damage it produces may be difficult to learn. The immediate effect of a single head-hit, for example, may be insufficiently aversive to punish the response. A single response might even temporarily relieve chronic nociceptive feedback from damaged tissue, and thus be reinforced. Gradual and cumulative damage may be severe, but it is not directly contingent on any one response.

Neurological abnormalities may thus be sufficient in self-injurious individuals to prevent them from learning from the aversive contingencies of their behavior. Indeed, self-injury in humans appears to be most frequent in members of the population with the most severe intellectual deficits (van Velzen, 1975). It would seem very plausible that this severely abnormal subpopulation would be comprised of individuals that cannot readily learn from their experience.

Abnormalities in Environment

Stress

Stressful stimulation has also been implicated in some forms of self-injurious behavior. For the present purposes, we might define *acute stress* as an immediate demand on the organism to behave in some fashion in order to adapt, and *chronic stress* as involving some such protracted demand requireing adaptation (Levine, 1976; Selye, 1973, 1976).

Observations of both humans and nonhumans suggest that self-injury can be elicited by acute stress. Yerkes (1925) and Frieh (1942) observed that self-mutilation and head-banging occurred in what they termed "frustrating" situations, while Tinkelpaugh (1928) observed that separation from a female occasioned self-injurious behavior in one male rhesus monkey. Erwin, Mitchell, & Maple (1973) found that self-injurious behavior occurred in nonisolated rhesus monkeys in stressful situations that did not allow appropriate direction of aggression toward others. Gluck and Sackett (1974) found that the probability of self-injurious behavior was increased in socially

isolated monkeys during the extinction of previously rewarded responses. In humans, Bryson *et al.* (1971), Korten *et al.* (1975), and Paul and Miller (1971) all reported that self-injury was most frequent following aversive and novel stimulation, usually being associated with tantrums or emotional outbursts.

Acute stressful stimulation could engender self-injurious behavior through any of several mechanisms. Acute stressors can produce marked biochemical changes, including increases in catecholamine utilization (Anisman, 1975, 1978; Weil-Maherbe, 1972; Yuwiler, 1971). Stereotypies and self-injury may be increased by stressors through the mediation of these changes in catecholamine utilization (deCatanzaro, 1978). If self-injurious behavior is attributable to motor patterns that are rigid, limited, and beyond voluntary control, general behavioral activation consequent to brief stressful stimulation might set the occasion for the behavior. Also, acute stressors will elicit aggressive responses in many species (Azrin, Rubin, & Hutchison, 1968; Scott, 1966; Ulrich & Azrin, 1962). If self-injurious responses are viewed as aggressive, it is consistent that their frequency be increased by stressful events. Elicitation of predispositions toward aggressive responses might therefore exacerbate the behavior or be a principal causative factor.

Not only does acute stress appear to increase the probability of self-injury; chronic stress may be involved as well. Many individuals exhibiting the behavior are malformed or damaged to an extent that renders survival and coping difficult. Chronic stress is known to be associated with major changes in hormonal levels, and neurochemical synthesis and utilization (Levine, 1976; Selye, 1976; Weil-Maherbe, 1972; see also Chapter 10). If neurochemical and hormonal changes were elicited by severe stress to an extent which went beyond the adaptation these changes normally provide, they might engender or aggravate physiological abnormalities leading to the breakdown of reinforcement, motor, or inhibitory mechanisms.

Moreover, recent evidence indicates that endorphins may be released in large amounts in response to stressful stimulation (see reviews by Barchas *et al.*, 1978; see also Chapter 10). Activity of endorphins is believed to reduce the organism's sensitivity to nociceptive or painful stimulation. In extremely stressed individuals their release in large amounts might readily facilitate self-injurious behavior by dulling responsivity to pain. This hypothesis would be testable through manipulations with drugs such as naloxone, which blocks endorphin activity.

Social Isolation

There have been several studies demonstrating that rearing primates in social isolation can engender chronic self-injurious behavior (e.g., Cross &

Harlow, 1965; Harlow & Griffin, 1965; Mason & Sponholz, 1963; Suomi, Harlow, & Kimball, 1971). Socially deprived primates show many of the same patterns that are observed in human cases, such as head-banging and self-scratching. The effect may be greater in completely isolated as compared to partially isolated monkeys, although both groups may show head-banging and other forms of self injury (Mason & Sponholz, 1963). Not only do social isolates show self-directed aggression, but they may also continue to attack older and stronger monkeys despite the fact that they may be severely defeated in such encounters (Cross & Harlow, 1965; Mitchell, 1968).

It seems possible that some degree of social isolation is involved in many human cases. Many self-injurious individuals have been separated from their families at an early age and placed in institutions where they receive little individualized care. It has also been noted that there frequently have been deficiencies in the contact between parent and child in self-injurious individuals (Ferenzi, 1955; Spitz, 1946).

While the effects of social isolation vary across species and depend on the degree of isolation and the developmental stage in which it occurs, such effects are usually pronounced (cf. Bennett & Rosenzweig, 1971; Brain, 1975; Cross & Harlow, 1965; deCatanzaro & Gorzalka, 1979; Melzack & Scott, 1957; Sackett, 1970; Sahakian, Robbins, Morgan, & Iverson, 1974). In some species, isolation can produce marked changes in hormones and neurochemistry, particularly changes in catecholamine utilization, which are associated with increased reactivity to stressful and novel situations (Anisman, 1978; Bennett & Rosenzweig, 1971). Isolation has also been reported to increase the incidence of stereotypies in animals treated with catecholamine stimulants (Sahakian *et al.*, 1974). Furthermore, isolation can increase the frequency of subsequent aggressive responses in many species (Bennett & Rosenzweig, 1971; Scott, 1966). All of these processes could conceivably be conducive to self-injurious behavior, although their involvement remains to be demonstrated.

The best clues as to the mediation of isolation-induced self-injury come from evidence that pain avoidance can be dramatically reduced in animals raised in social isolation. Melzack and Scott (1957) reared Scottish terriers in isolation and noted several bizarre responses to noxious stimulation in postrearing tests. Isolated dogs showed major deficits in the acquisition of shock avoidance and escape tasks, receiving more shocks than socially raised dogs and requiring higher shock intensities to learn. Also, normal dogs would quickly learn to avoid the experimenter after he burned their noses with a flame, while isolated dogs showed little avoidance of this stimulus. Such deficits in avoidance of aversive stimuli were evident even when dogs were tested 2 years after release from isolation. Lore (1969) has demonstrated similar deficits in pain avoidance in isolation-reared rats; this effect

was much larger in a novel environment than in the animals' home cages, which Lore attributed to hyperemotionality produced by the strange environment.

Lichstein and Sackett (1971) found that rhesus monkeys raised in social-sensory isolation showed much greater tolerance of shock than socially reared monkeys. The isolate monkeys demonstrated some signs of reaction to shock, in that they preferred to drink from a nonshocking over a shocking drinking tube and were initially more reactive to very low current levels. However, isolates would tolerate much higher levels of shock when required to do so to obtain water. Lichstein and Sackett (see also Sackett, 1970) have suggested that problems in pain responsibility after isolation may be due to a lack of learning regarding response inhibition as much as pain perception deficits; this distinction may suggest an important focus for future research.

Learning Revisited

There still remains a wealth of literature indicating that proximate antecedent and consequent social stimuli control the frequency and topography of self-injurious behavior. There are quite a number of recent reviews of such literature (Bachman, 1972; Carr, 1977; Frankel & Simmons, 1976; Lester, 1972a; Smolev, 1971). The concensus is that self-injurious behavior is maintained as an operant response by contingencies of reinforcement; often, the reinforcers are social in nature. The frequency of the behavior is believed to be affected by rewards given by caretakers, and indeed there is solid evidence to support this as reviewed at the beginning of this chapter. In Chapter 14 a similar tendency of individuals to self-injure for social rewards was discussed; that was parasuicide. In Chapters 6 and 9 the importance of social contacts in determining suicide frequency was discussed; many of the relevant principles are the same, but self-injurious or self-mutilative behavior is very different from suicide. There is no doubt that *Homo sapiens* is a very social species and one which involves great interdependency. There can be little doubt that social reinforcers are strong for this species.

It has been argued in this chapter that physiological and developmental anomalies may be directly conducive to self-injurious forms of behavior. Whether the animal evidence entirely speaks to the human evidence could be questioned, however the self-injurious behavior of primates housed in social isolation (e.g., Harlow & Griffin, 1965; Mason & Sponholz, 1963) seems quite relevant to human cases. Also, there is little question that serious brain malformation or damage is almost universal in the populations displaying self-injurious behavior (Harris, 1972; Maisto, Baumeister, and Maisto, 1978; O'Connor, 1972; van Velzen, 1975; Watts, 1978).

In many cases reinforcement contingencies could act as strong secondary etiological factors. Stereotyped behavior resulting from unconditioned factors might occasionally lead to head-banging or head-hitting, which could come under the influence of reinforcers. Green (1967) suggested that rhythmic stereotypies might gradually come under the control of social reinforcers as caretakers in institutions reward self-injurious children. A child with difficulties with response inhibition and pain perception would also be more prone to self-injure for social reinforcement; the disincentive would be removed. The effectiveness of reinforcement over self-injuring behavior may thus be facilitated by stereotypic bodily movements and pain perception and avoidance difficulties. There may also be cases in which reinforcement is the principal cause, but despite many efforts such cases have not been unequivocally demonstrated. Nonetheless, there remains legitimate reason to believe that both social and nonsocial reinforcement could contribute to self-injury, perhaps through increased sensitivity to such reinforcers due to social and stimulus deprivation. The evidence would at least indicate that the behavior's consequences may alter its topography in some but not all cases.

Behavior modification programs may have positive effects in some self-injurious individuals where brain mechanisms involved in reinforcement processes are intact. For example, in an individual whose self-injurious behavior stems from pain insensitivity, reinforcement mechanisms may still operate to guide development of behavioral topography. Punishment, such as electric shock, may be most effective where it is the ineffectiveness of the contingency of cumulative damage that is the primary cause of self-injurious behavior but where some responsiveness to aversive stimulation remains. Where stereotypies are involved, a forced arm exercise or pharmacologic treatment might be most effective. At least some of the effectiveness of many treatments, however, may stem from confounded changes in the degree of stress and social isolation experienced by subjects.

Relationship to Adaptation

Insofar as self-injurious or self-mutilative behavior occurs among neurologically nonintact, developmentally deprived, and genetically abnormal individuals, its non-life-preserving aspect is not difficult to explain. Behavioral expression in extremely abnormal conditions need not be life-preserving, since gene expression should only be conducive to normal behavior in environments like that in which it was shaped by natural selection. As such, the explanation of such behavior follows directly from the discussion of Chapter 7. Self-injurious and self-mutilative behavior do share the antecedents with suicide and some other chronic self-damaging behavior of chronic stress and social isolation, as well as the life-threatening consequence. However, it is

clear that some very special considerations of physiological, developmental, genetic, and social variables make chronic, repetitive self-injury of a different nature from suicide.

There is clearly substantial variance in the primary abnormalities associated with self-injurious behavior. Some cases are associated with identifiable genetic and chromosomal abnormalities (e.g., Lesch & Nyhan, 1964; Parker *et al.*, 1970), others with physiological disturbances (e.g., Korten *et al.*, 1975; Randrup & Munkvad, 1969), still others with severe environments (e.g., Cross & Harlow, 1965; Mason & Sponholz, 1963). Also, there is considerable variability in the responsiveness of the behavior to extrinsic reinforcement and punishment (cf. Bucher & Lovaas, 1968; Corte *et al.*, 1971; Lovaas & Simmons, 1969; Romanczyk & Goren, 1975; see also review by Smolev, 1971). Similarly, drug treatments appear to be more effective in some individuals than others (Burk & Menelescino, 1968; Corbett, 1975; Hacke *et al.*, 1978; Lycaki *et al.*, 1979; Primrose, 1979; Schroeder *et al.*, 1978). The common thread, however, seems to be development in an extremely abnormal environment.

It is curious that in modern culture the lives of those with virtually no hope of recovering fitness, as are those with severely debilitating neurological disorders, are preserved at great cost. This illustrates again a point made in Chapter 12 about the life-preserving orientation of modern human ethics. In many cultures in previous human history and in other mammalian species it may have been common for caretakers to fail to nurture less viable offspring, and there indeed may be some vestiges of this in modern human culture (see review by Daly & Wilson, 1980).

17

Toward an Expansion of Research Paradigms

I would like first in this chapter to give a brief supersynthesis regarding the biology of self-damaging forms of behavior. I will then discuss the role of evolutionary concepts in the explanation of such behavior and suggest some focuses for future research.

Self-Damaging Behavior: A Supersynthesis

It appears that there are many specific and unique determinants of each of the forms of self-damaging behavior discussed. Nonetheless, some commonalities are present. There is evidence that chronic coping difficulty is an antecedent of a large number of cases of diverse forms of self-damaging behavior. Accordingly, these behavioral patterns share a rough relationship to selective pressures, occurring in many instances where the capacity to promote inclusive fitness is low. Having such an ecological position renders any effect of selection pressures in reducing their incidence a slow process at best. Several generations may be required for any behavioral predispositions to develop to alter the frequency and nature of such acts such that they occur only in adaptive contexts. Pathological conditions arising in those with a very low capacity to promote inclusive fitness are not readily amenable to the influence of individual selection (see Chapter 8). Individual selection can only act upon residual reproductive potential; if this is low when the pathological behavior arises, natural selection has little to affect. Kin and group selection could conceivably act in some instances upon behavioral expression in such circumstances over several generations (see Chapter 9). However, many of the non-life-preserving forms of behavior are recent occurrences in evolu-

tionary history, facilitated by novel cultural and technological circumstances. For example, modern suicides may be facilitated by new painless modes of death, alcohol disorders by the recent availability of distilled liquor, accidental death by technological change, and drug abuse by pharmacological technology and transportation. There is no selective pressure that could prepare behavioral predispositions for historically novel environments.

Another commonality of most of these self-damaging behavioral patterns is their predominant occurrence among males. This is true of suicide, alcoholism, abuse of many drugs, accidental death and risk-taking, and engagement in warfare. Males appear to take a more experimental, higher-risk coping strategy than females (see Daly & Wilson, 1978; Symons, 1980; Chapters 5 and 8), and mortality at all ages appears to be higher among males from diverse causes (McKusick, 1969; Retherford, 1975). For suicide this higher frequency among males holds in most cultures in which it has been examined. The pattern is reversed, however, for parasuicide (Kreitman, 1977; Stengel, 1973) and there is some evidence indicating a higher frequency of abuse of some drugs such as barbituates (Julien, 1978) and of self-injurious or self-mutilative behavior (Maisto, Baumeister, & Maisto, 1978) among females.

Apart from these general commonalities, and the commonality in potential to hasten death, the various forms of self-damaging behavior appear to be unrelated in proximate causation. Although the psychiatrists have frequently spoken of common underlying determination of diverse forms of self-damaging behavior (e.g., Lettieri, 1978; Menninger, 1938); this may overstate the relationship. Some commonality of determination is possible, but each form of self-damaging behavior appears to be a synergy of diverse factors, with many of the factors being specific to the particular form of behavior and indeed specific to the individual case.

Critical Issues for Research

Any postulates that I have derived from the available data need to be scrutinized by additional research and theory. Some of the hypotheses concerning evolutionary processes may appear difficult to test. Because of the extratemporal aspect of these global hypotheses, it is difficult within any one generation to observe them directly. But this does not imply absolute untestability; the careful collection of information over generations may produce a gradual accumulation of relevant data. Indeed, data from countries that have long kept records of births, deaths, marriages, and other vital statistics, such as the Scandinavian countries, could be used to address these issues. Historical, anthropological, archaeological, and animal behavioral

data are also relevant. Zoologists, population geneticists, and ecologists have also long been developing mathematical models to examine the validity of hypothesized evolutionary processes (e.g., Boorman & Levitt, 1973b; Charnov, 1977; Hamilton, 1964; D. S. Wilson, 1975); this process could be extended to the study of human behavior.

Moreover, there are numerous corollaries of hypotheses developed from evolutionary reasoning that are directly testable. Such hypotheses entail predictions about the configuration of current events; by examining this configuration the plausibility or lack of plausibility of the more general processes should become apparent. Evolutionary theory has become the unifying basis of modern biological reasoning and is now well supported by a wealth of data. Social and behavioral science necessarily will ultimately be based in biological science, since all behavior, social or otherwise, is a function of biological organisms that have been shaped by evolution. It follows that hypotheses based in evolutionary reasoning have a rightful place in social and behavioral science. By focusing only on proximate determination, social and behavioral scientists have often missed the general notions that may readily explain the relationships among proximate determinants.

Many specific testable postulates have been outlined in previous chapters. I would like now briefly to review some critical focuses for future research.

Learning versus Innate Determination

Particularly with respect to suicide, the question arises as to the extent to which learning experience determines the inclination toward self-destructive behavior. It has been argued that it is plausible that changes in gene expression affecting motivational states could be conducive to suicidal motivation. It is also known, however, that vicarious learning contributes to the incidence of suicide (Hankoff, 1961; Phillips, 1974). Studies should focus upon the extent of learning about suicide in case histories of those committing the act. We need data allowing a partitioning of learned and nonlearned aspects of suicidal behavior. This may require an aggregation of large samples of relatively thorough and accurate case history information. This endeavor is limited by several factors, including the retrospective nature of such case studies, the social isolation of suicidal individuals, and the reliance upon accounts by others of the individual's experience (see discussion by Neuringer, 1962). Also, techniques of behavioral genetic analysis should be applied to suicide; the only studies to my knowledge have been those of Kallmann and associates (Kallmann & Anastasio, 1947; Kallmann, DePorte, DePorte, & Feingold, 1949). As was explained in Chapter 8, behavioral genetic studies define only contributions of genetic differences to interindividual variance.

The gene-expression involvement in suicide contingent on changes in coping status may be best examined through physiological study of motivation and study of the role of learning experience.

Biological Fitness and Self-Damaging Behavior

In Chapter 5 it was explained how the epidemiologic evidence on suicide could be viewed as indicating that suicide generally occurs where residual reproductive capacity is low. This was based primarily on aggregate statistics as analyzed by sociologists and fragmentary accounts of proximate stresses precipitating suicides. Again, what is needed is a thorough examination of accurate and unbiased case history data. The validity of the postulates may be determined by an analysis of more detailed accounts of proximate determinants. While case histories have previously been examined by several researchers, none of these have focused specifically upon biological fitness and its relationship to suicide. Special attention should be given to cases where some residual fitness is lost through suicide. A thorough examination of case histories among adolescent and young adult suicides should be conducted with attention to parameters of inclusive fitness. Attention may also be focused, for example, upon the prevalence of suicide among postmenopausal women as it relates to residual capacity for kin- and group-promoting activity. This social-ecological approach could be extended to forms of self-damaging behavior other than suicide. The aggregation and analysis of thorough case study information seems to be the best available scientific method for a detailed analysis of the role of biological parameters in self-damaging behavior. This might be complemented by further sociological and epidemiologic studies taking a multivariate approach and examining more detailed aspects of the social ecology.

Role of Pathology and Ecological Novelty in Self-Damaging Behavior

Many of the analyses of the relationship of psychopathology to self-damaging behavior have not been especially instructive. This stems largely from the fact that biological definitions of states of pathology have not been derived, as well as from variance in diagnostic criteria among clinicians. We need to differentiate between the role of stress or pathology as antecedent conditions indirectly conducive to suicidal behavior and suicide itself as a pathological condition. Research focusing upon the causative chain in the relationship of coping failure and suicide would be particularly valuable. This type of analysis could also be extended to other forms of self-damaging behavior that are apparently facilitated by chronic stress and coping failure.

Moreover, the role of ecologically or historically novel environments as determinants should be given greater attention. The role of novel environments in the origin of diverse forms of modern self-damaging behavior has repeatedly been apparent in the discussions in this volume.

Technology and Self-Damaging Behavior

A related focus of research could be concerned with the relationship of technologically novel conditions as they facilitate suicide and other self-damaging behavior. It is clear that there have been rapid transitions in the technology employed in the act of suicide in modern societies. Does the availability of several new means of effecting death increase the incidence of the act, or has it simply altered the methods employed by those that show suicidal motivation? Has the character and social ecology of suicide been transformed by technological change? It is conceivable that more impulsive and biologically maladaptive forms of self-destruction have been facilitated by the availability of new modalities for self-effected damage and death. Related studies may focus on a comparative analysis of suicide in previous history and modern times.

Cross-Cultural Comparisons

The most thorough data collection and analysis have come from North America, Europe, and Japan. Comparably thorough studies are lacking for many other parts of the world. Data from studies in other cultures would greatly enhance scientific knowledge of phenomena such as suicide. It would provide a basis for stronger statements about the roles of cultural norms, ethnic traditions, race and gene flow, technology, and culture-specific stresses in the etiology of suicide. It might furthermore help us to partition the roles of learning and gene expression in determining the incidence of suicide; the influence of cultural norms and extent of differences in cultural patterns of suicide might especially elucidate this issue. Researchers might also give more attention to cross-cultural and historical dimensions in discussions of suicide and other self-damaging behavior; too often, strong inferences have been drawn on the basis of very limited data bases without heed to the global nature of the phenomena.

Cognition and Suicide

Although several researchers have focused on cognitive aspects of suicidal behavior, there has been inadequate attention to the relationship of thought processes to other determinants of suicide. Are cognitive states of

hopelessness and desperation simply concomitants of suicidal behavior or are they critically involved in the determination of the act? Is suicide strictly an act that is conceived through cognition and vicarious learning or do these factors act in coordination with nonassociative motivational changes occurring in times of coping failure? The examination of cognitive components of suicidal behavior in isolation from other factors may have some value, but it is essential that we understand how cognition interacts with other determinants.

Altruism and Suicide

Although Durkheim postulated that altruism might be involved in suicide, his definition of altruism differed somewhat from that of modern sociobiology, and there has been little thorough assessment of the relationship of kin/group solicitude to suicide. Future research could focus upon the expected impact of suicide on kin, the actual impact on kin, and changes in the individual's inclusive fitness contingent upon suicide. Data regarding kin-group solicitude in suicide in societies with relatively stable ecological circumstances might be particularly valuable for an understanding of the origin of suicide, although we are rapidly losing this opportunity as more primitive cultures are disrupted by technologically advanced cultures. In the modern circumstance, kin networks have often been altered dramatically and social groupings have become much larger. This may have changed altruistic aspects of suicide insofar as the act now occurs in a socially novel context. The role of social isolation in the causation of suicide needs to be examined in more detail; one suggestion in previous chapters was that social isolation represented a loss in the ability to promote inclusive fitness. Similarly, we need more information on the relationship of guilt, shame, transgression of mores, and burdensomeness to the act of suicide.

The Physiology of Motivation

There has been much development in the study of neurological and hormonal concomitants of motivational and emotional states. Particularly valuable for our purpose has been evidence concerning physiological correlates of states of euphoria and dysphoria, depression, chronic stress, and other aspects of affective states. Undoubtedly, research in coming years will bring further revelations relevant to our purposes. This work may facilitate the partitioning of associative and nonassociative processes in suicidal motivation. This process may be advanced by more concerted attention to the question of suicide and other life-threatening forms of behavior engendered by coping failure. Much research concerning physiological deter-

minants of drug abuse is currently being conducted. A greatly insufficient amount of attention has been given to physiological determinants of self-injurious or self-mutilative behavior.

Self-Destructiveness in Other Species

Relatively little is known about self-destructive acts in other species, despite recent surges of interest and research in ethology and experimental animal psychology. We are forced to conclude from current evidence that self-destructiveness is rare in nonhuman species, but this may derive more from a lack of positive findings than from negative findings. Clearly, any self-destructive acts among nonhuman animals could not be entirely similar to human suicide given the involvement of technology and cognition in the human acts. However, it is possible within an experimental context to examine motivational changes engendered by chronic stress or by permanent impediments to effective coping in nonhumans. Such work would have obvious implications for an evolutionary perspective toward suicide and self-damaging behavior.

Final Statement

There were several other specific suggestions for research made in previous chapters; these need not be reiterated here. In summary, the emphasis of future research might be shifted to test hypotheses based upon evolutionary and ecological principles.

We need to bring social science into the realm of general science. There has been inadequate communication between ecological areas of biological science and social and behavioral sciences. The physiological psychologists are succeeding in integrating physiology with behavioral science. The sociobiologists and behavioral ecologists are only beginning to integrate their work with that of psychologists, sociologists, and anthropologists; increasingly, those from the latter disciplines are attending to biological and evolutionary dimensions of social behavior. We need more often to assimilate each other's work. Much of the focus of modern science has been on examining the intricacies of microcosms. While such work is the essence of science, a macroscopic perspective, integrating diverse disciplines where they are relevant to a particular question, is also essential for the explanation of complex phenomena.

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